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Arable Update

Cereals: Issue 235

Managing SDHIs for prolonged performance in autumn sown wheat

Background

Rising costs and the spread of fungicide resistance make selecting the right fungicide programme both more important and more complex.

Since their introduction in 2010, succinate dehydrogenase inhibitor (SDHI, Group 7) fungicides have provided excellent control of Septoria tritici blotch (STB) in autumn sown wheat. However, as highlighted in Cereal Update 234, *Zymoseptoria tritici* (*Zt*) (the pathogen causing STB) is showing reduced sensitivity in laboratory tests to key SDHI active ingredients, including benzovindiflupyr (Elatus™ Plus), isoflucpyram (Caley® Iblon® and Vimoy® Iblon®), and fluxapyroxad (Revystar®).

In response, programme decisions must carefully balance the number of applications, combine different mode-of-action (MoA) chemistries in spray mixtures, use appropriate dose rates, and alternate not only SDHIs but also their mixing partner active ingredients (Table 1).

This Arable Update outlines practical strategies for using SDHIs effectively in the field while protecting their long-term efficacy.

When and what SDHIs to use in autumn sown wheat

SDHIs are highly effective but also the most expensive component of a fungicide programme in autumn sown wheat. For this reason, they are typically reserved for protecting the flag leaf, which contributes up to 43% of final yield. Whether a second SDHI is used depends on cost and seasonal conditions, with a statutory maximum of two applications permitted per season.

FAR trials have consistently shown little benefit from applying a second SDHI — with no significant improvements in disease control, yield, or economic returns, even under high disease pressure. Combined with the emergence of cross-resistance among SDHI active ingredients, there is now a strong argument for limiting their use to a single application each season.

Laboratory testing shows a gradual decline in *Zt* sensitivity to SDHI fungicides, though they remain effective at field rates. The most notable shifts have occurred with fluxapyroxad (the SDHI in Revystar®), which has been on the market longer than other SDHIs.

Key points

- In New Zealand, *Zymoseptoria tritici* (*Zt*), the cause of Septoria tritici blotch (STB) in wheat, is showing a gradual reduction in sensitivity to Succinate dehydrogenase inhibitor (SDHI) (Group 7) fungicides in the laboratory.
- SDHI fungicides remain effective at field rates. However, careful stewardship – limiting the number of applications, mixing fungicide mode of action (MoA) groups and appropriate dose - are now essential to protect their ongoing usefulness.
- Picking the right mixing partner helps to protect field performance and the long-term sensitivity of all the components of a fungicide mixture.
  - FAR fungicide trials in Mid Canterbury, South Canterbury and Southland show different SDHIs and their respective mixing partners provide largely comparable disease control, yield and economic returns.

How to protect SDHIs

Mixing partners play and important role in protecting at-risk active ingredients like SDHIs (Table 1). For example, of the three active ingredients tested in the lab, *Zt* was the least sensitive to fluxapyroxad. In Revystar® fluxapyroxad is co-formulated with the traizole (Group 3) mefentrifluconazole, which was the most sensitive of the triazoles tested (see Cereal Updates 232 and 234).

Vimoy® Iblon® (isoflucpyram) and Elatus™ Plus (benzovindiflupyr) are both solo SDHIs and must be applied with a mixing partner of your choice.

It can be tempting to save costs by selecting cheaper mixing partners for SDHIs, but be aware this may compromise field control and may put both the SDHI and triazole at risk of losing field efficacy due to resistance. To protect SDHIs, always apply at appropriate rates with an effective mixing partner (Table 1).

Field trials in Mid Canterbury with irrigation and South Canterbury and Southland without irrigation showed different SDHIs and their respective mixing partners provided largely comparable disease control, yields and economic returns, offering growers flexibility in selecting the best strategies for their crops (Tables 2-4).

Table 1. Fungicide Resistance Industry Initiative guidelines for use of SDHI (Group 7) fungicides to control STB and leaf rust. Adapted from AHDB fungicide futures.

DON'T	• Apply any more than twice to any cereal crop. • Apply without a mixing partner. • Apply only with a strobilurin (Group 11) as a mixing partner.
AVOID	• Applying when disease risk does not merit it e.g. do not use two applications when the disease pressure only requires one. • Applying with only a multi-site as a mixing partner.
DO	• Follow the statutory requirement to limit the number of applications to a maximum of two SDHI fungicide containing sprays per season. • Alternate SDHI active ingredients both within and between seasons. • Alternate mixing partners ensuring they always have efficacy against the target pathogen too.

Table 2. Percent leaf area affected by STB and leaf rust, yield and margin over fungicide cost (MOFC) for autumn sown wheat, cultivar Graham with 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. SDHI (Group 7) active ingredients at GS 39 (T2) highlighted in different colours.

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 applications of different fungicide programmes. Disease assessed on the flag leaf – leaf 3 at GS 85 on 6 January 2025. SDHI (Group 7) active ingredients at GS 39 (T2) highlighted in different colours.

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)
Untreated	-	-	95.9	87.6	100	9.0	*
Kestrel® (1.0) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Revylution® (1.5)	Opus® (1.0) + Comet® (0.4)	21.6	13.3	29.8	12.7	1263
Kestrel® (1.0)	Vimoy® Iblon® (1.5) + Revylution® (1.5)	Opus® (1.0) + Comet® (0.4)	25.6	17.3	33.8	12.4	1149
Bolide® (2.0) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Revylution® (1.5)	Prosaro® (1.0) + Comet® (0.4)	27.9	19.6	36.2	11.6	814
Revylution® (1.5) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Kestrel® (1.0)	Opus® (1.0) + Comet® (0.4)	22.9	14.7	31.2	12.9	1338
Questar™ (1.5) + Kestrel® (1.0) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Revylution® (1.5)	Opus® (1.0) + Comet® (0.4)	16.1	7.9	24.4	12.8	1219
Kestrel® (1.0) + Phoenix® (1.5)	Revystar® (1.5)	Opus® (1.0) + Comet® (0.4)	25.5	17.2	33.7	12.3	1103
Kestrel® (1.0) + Phoenix® (1.5)	Elatus™ Plus (0.75) + Revylution® (1.5)	Opus® (1.0) + Comet® (0.4)	22.3	14.1	30.6	12.4	1122
Kestrel® (1.0) + Phoenix® (1.5)	Questar™ (1.5) + Revylution® (1.5)	Opus® (1.0) + Comet® (0.4)	22.0	13.7	30.2	12.6	1248
Proline® (0.64) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Revylution® (1.5)	Opus® (1.0) + Comet® (0.4)	26.6	18.4	34.9	12.4	1155
Proline® (0.4) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Revylution® (1.5) + Phoenix® (1.5)	Opus® (1.0) + Comet® (0.4)	23.1	14.8	31.3	12.4	1155
Questar™ (1.5) + Proline® (0.64) + Phoenix® (1.5)	Vimoy® Iblon® (1.5) + Revylution® (1.5)	Opus® (1.0) + Comet® (0.4)	13.8	5.6	22.1	13.0	1315
		Mean	**28.6**	**-**	**-**	**12.2**	**1171**
		P value	**<0.001**	**-**	**-**	**<0.001**	**NS**
		LSD (P=0.05)	**-**	**-**	**-**	**0.48**	**-**
		CV (%)	**-**	**-**	**-**	**3.9**	**-**

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 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	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	QiI	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.

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