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Arable Update

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Building a stem rust programme for perennial ryegrass seed crops

Background

FAR-funded trials conducted before about 2010 typically began fungicide programmes around flowering, once stem rust was already visible. By that stage, infection had often already established in the upper canopy, meaning some seed yield potential may already have been lost before the first fungicide application was made. Improved understanding of stem rust and the protectant activity of modern fungicides have seen a shift from this reactive approach in favour of preventative applications timed at key stages of crop development.

The resulting programme is straightforward in principle.

1. Protection should begin around early stem extension (i.e. growth stage [GS] 32, two nodes detectable).
2. Be maintained through head emergence (GS 59)
3. The upper canopy should be protected through flowering (GS 61-69) and early seed fill.

Each fungicide timing serves a distinct purpose. The GS 32 application limits early disease development as reproductive stems begin to extend. The head-emergence application protects newly exposed leaves, sheaths, stems, and seed heads. The flowering application maintains a green upper canopy through the critical seed-filling period and aims to extend protection towards cutting. Exact intensity will still vary with cultivar susceptibility, paddock history, disease pressure, and weather, but the New Zealand evidence points consistently to the same conclusion: delaying the start of the programme until flowering is less effective than beginning earlier.

Key points

- Fungicide timings should be anchored to crop growth stage.
- Intervals should reflect weather, disease pressure and product persistence.
- Match programme intensity to risk.
- For endophytic varieties confirm your fungicide choice with your seed company.
- Check withholding periods.

Timing is critical

The 2020-21 Greendale trial shown in Table 1 provides a particularly clear demonstration that application timing is more important than application number.

Table 1. Effect of fungicide programme on seed yield in an 'AllSport' turf-type perennial ryegrass field trial at Greendale, 2020–21 (LSD: 153 kg/ha, P value: P≤0.001).

Programme	Timings used	Seed yield (kg/ha)
Untreated	None	1028
Two applications, late	Flowering, flowering + 14 days	1793
Two applications, early	Two nodes, head emergence	2298
Three applications	Head emergence, flowering, flowering + 14 days	2392
Three applications, from two nodes	Two nodes, head emergence, flowering	2500
Four applications	All four timings	2595

Two early applications, at GS 32 and head emergence, produced 2,298 kg/ha, 505 kg/ha more than two late applications, at flowering and flowering plus 14 days (Table 1). Adding a flowering treatment after the two early applications increased seed yield by a further 202 kg/ha, while adding a fourth application, at flowering plus 14 days, added only 95 kg/ha, less than the trial's LSD of 153 kg/ha. Both comparisons involve the same number of applications, yet produce markedly different results, which is why application timing matters more than the number of applications.

Setting the interval between applications

Fungicide timings should be anchored to crop growth stage (such as GS 32, head emergence or flowering), but the interval between applications should also reflect recent weather, disease pressure, the time since the last application, and the persistence of the product used.

Temperature strongly affects how quickly stem rust cycles. A spore-to-spore cycle takes approximately 13 to 17 days at 10°C, compared with only 8 to 9 days at 18°C and above (Pfender, 2001). In a warm spring, rust may develop more quickly, so a spray interval that works in a cool spring can leave room for two full disease cycles before the next application. However, in warm seasons the crop also moves through its growth stages more quickly, so calendar dates can be misleading.

Matching programme intensity to risk

Start the season with a defensible plan, not a fixed recipe. Table 2 combines information about cultivar susceptibility, the seasonal risk indicators, and the timing evidence presented above to define starting positions for three broad risk situations. These programmes describe what the available evidence supports, rather than replacing product-label directions, and should be adjusted as the season develops.

Table 2. Indicative starting programmes by risk situation, drawn from the New Zealand trial evidence and current FAR guidance.

Risk situation	Typical crop	Starting programme	Adjust during the season
Lower risk	New Zealand-bred forage-type cultivar, no history of severe rust on the property	Fungicide with the GS 32 plant growth regulator (PGR), plus one application at head emergence	Add a flowering application if conditions turn conducive or rust appears in the upper canopy
Moderate risk	Overseas forage-type or NZ bred turf-type cultivar in a district or season with known rust pressure	Fungicide with the GS 32 PGR, then head emergence and late flowering	Shorten intervals in warm spells; consider a fourth application only if rust pressure persists late
Higher risk	Overseas turf-type cultivar	Three to four applications, beginning at GS 32 and covering head emergence and flowering	Hold the early timings regardless; decide the final application based on late-season rust pressure and withholding periods.

Checklist

- Begin the programme before stem rust is readily visible.
- Build protection around GS 32, head emergence, and flowering.
- If only two applications are justified, prioritise the earlier timings over the later ones.
- Treat any application later than flowering as an in-season decision, not a routine fourth application.
- Base the fourth-application decision on:
  - Continuing rust pressure.
  - Temperature.
  - Remaining green crop area.
  - Expected cutting date.
  - Treatment economics.
  - Withholding periods.
- A late application is most likely to be justified where:
  - Stem rust pressure remains high after flowering.
  - Warm conditions favour continued disease cycling.
  - Susceptible green tissue remains that can contribute to seed filling.
  - Sufficient time remains before cutting and all withholding periods can be met.
  - The likely yield response exceeds the marginal cost of treatment.

Resistance management considerations

Effective fungicide resistance management relies on reducing selection pressure while maintaining robust disease control. No single fungicide active ingredient controls every disease in every situation. Disease management in perennial ryegrass seed crops therefore combines effective modes of action with agronomic practices that reduce disease pressure.

Resistance principles

The general principles below apply across fungicide groups, but they must be supplemented by the group-specific restrictions and mixture requirements described in Table 3.

1. Use different modes of action.
2. Count each group in co-formulated products.
3. Apply fungicides preventatively.
4. Use effective rates.
5. Limit applications of high-risk fungicides.
6. Integrate chemical and non-chemical control.

Table 3. Summary of resistance risk and the recommended strategy for the main fungicide groups used in perennial ryegrass seed crops.

FRAC resistance group	Example active ingredients	Resistance risk	FAR strategy	FRAC seasonal guidance
Group 1 – Benzimidazoles (MBC)	Carbendazim	**High**	Mixture or alternation with an effective partner; full label rate	Label maximum; avoid repeated use
Group 3 – DeMethylation Inhibitors (DMIs)	Tebuconazole, Prothioconazole, Epoxiconazole	**Medium**	Mixture or alternation; robust rates	Label maximum e.g. three per season
Group 7 – Succinate DeHydrogenase Inhibitors (SDHIs)	Benzovindiflupyr, Isoflucypram, Fluxapyroxad	**Medium to high**	Always in mixture with an effective partner; preventative use	Label maximum No ryegrass specific guidance [Cereal guidance – no more than two per crop]
Group 11 – Quinone outside Inhibitors (QoIs)	Azoxystrobin, Pyraclostrobin	**High**	Always in mixture with an effective partner; preventative use	Label maximum [Cereals guidance – no more than two per crop]

Note: Example active ingredients are listed for identification only. Always confirm registration for perennial ryegrass seed crops on the current product label.

Off-target resistance risk: Fungicides applied for stem rust can also expose non-target pathogens present in the crop to the same fungicide modes of action. Where these pathogens are repeatedly exposed during or across growing seasons, selection pressure may favour less-sensitive individuals. Resistance management should therefore consider selection pressure across all diseases exposed to the fungicide programme.

Withholding period considerations

Fungicide withholding periods are an important consideration when managing stem rust and other diseases in perennial ryegrass seed crops. They become particularly important where the residue and seed (including offal) will be used as animal feed.

When products are registered under the Agricultural Compounds and Veterinary Medicines (ACVM) Act 1997, they are required to include withholding periods for both re-entry of livestock to the treated paddock, and for the use of forage (including straw). Withholding periods are mandatory, and they exist to prevent the accumulation of fungicide residues in livestock.

As seed harvest approaches, any fungicide application should be planned to ensure the product's withholding period can be met before cutting. Where a proposed application would create a withholding period conflict, growers have three options:

1. Do not apply the fungicide, accepting the potential yield loss associated with unmanaged disease pressure.
2. Apply the fungicide but prevent livestock access by burning or incorporating the straw and seed residues.
3. Undertake residue testing to confirm fungicide residues are at or below the applicable maximum residue limit (MRL).

For all fungicide products, harvest is defined as cutting, not threshing. However, product labels often distinguish between withholding periods for perennial ryegrass seed (grain) and forage. Forage applies to any material that will be grazed or otherwise consumed by animals, including straw. For example, the label for Proline® carries a 14-day withholding period for the seed. However, if straw or seed (offal) becomes animal feed, the withholding period extends to 35 days from the date of application to the date of cutting. If you cut the crop within this 35-day window, the straw cannot be used for livestock consumption, as this would breach the withholding period.

Table 4 shown below summarises the withholding periods for the principal active ingredients used on New Zealand perennial ryegrass seed crops. Please check individual product labels carefully, including generic versions of common brands, as these periods can differ significantly between products. If in doubt, contact the agrichemical supplier or manufacturer directly.

Table 4. Product name, active ingredient, FRAC resistance group and withholding periods for fungicide products approved for use on perennial ryegrass seed crops in New Zealand.

Product	Active Ingredient	FRAC Resistance Group	Withholding period	Other label considerations
Protek®	Carbendazim	1	Seed – 14 days Grazing – 35 days	None
Opus®	Epoxiconazole	3	Grazing – 35 days	None
Proline®	Prothioconazole	3	Seed – 14 days Grazing – 35 days	None
Folicur® SC	Tebuconazole	3	Seed & Grazing – 30 days	None
Tilt® 500 EC	Propiconazole	3	Seed & Grazing – 28 days	None
Kestrel®	Prothioconazole + Tebuconazole	3	Seed – 30 days Grazing – 35 days	Minimum interval period of 21 days.
Prosaro®	Prothioconazole + Tebuconazole	3	Seed – 30 days Grazing – 35 days	None
Comet®	Pyraclostrobin	11	Grazing – 35 days	None
AMISTAR®	Azoxystrobin	11	Seed – 35 days Grazing – 28 days	None
SEGURIS® Flexi	Isopyrazam	7	14 days	Use in combination*.
ELATUS® Plus	Benzovindiflupyr (SOLATENOL®)	7	Seed – 14 days	Use in combination.
VIMOY® iblon	Isoflucypram	7	Grazing – 49 days Straw/stubble – 35 days	Use in combination. Apply up to GS 61.

* To reduce the risk of resistance developing, apply in a tank mix with a fungicide from a different mode-of-action group that is independently effective against the target disease at the rate used.

Note: For withholding periods, “seed” means that the seed crop should not be harvested within the period. “Grazing” covers all forage, including straw, and means that stock cannot re-enter the paddock until after the period has ended, as long as straw has been removed.

Please note: Information is correct at the time of publication (November 2026). Check current product labels for registrations, withholding periods and use restrictions.

Consideration for endophytes in perennial ryegrass

Many New Zealand-bred forage-type perennial ryegrass cultivars carry a selected *Epichloë* endophyte such as AR1, AR37 or NEA2. The endophyte is also a fungus, so it can be susceptible to fungicides used for stem rust management. Protecting the endophyte is important because seed lines that fall below the contracted endophyte standard can be downgraded or rejected, even when seed yield and germination are good. The endophyte cannot be reintroduced into seed once it has been lost, and its viability may continue to decline during seed storage.

- Endophyte response to fungicides varies by strain.
- Identify the endophyte strain carried by the cultivar and confirm the seed company’s endophyte requirements before finalising the fungicide programme.
- For AR37 and similar sensitive strains, limit the total number of triazoles applied across the season, and count any DMI applied with the GS 32 PGR in that total.
- Avoid repeating high-rate DMIs, particularly Proline® and Opus®-based programmes through flowering and seed fill on sensitive strains.
- Folicur®-based programmes, with strobilurins, SDHI or carbendazim as partners, have the best track record for keeping the AR37 endophyte high.
- Endophyte losses can continue after harvest. Keep windrow time short, cool and dry the seed promptly.

References

Fungicide Resistance Action Committee (FRAC). FRAC Code List and recommendations for fungicide mixtures and resistance management. www.frac.info

Pfender, W. F. (2001). A temperature-based model for latent-period duration in stem rust of perennial ryegrass and tall fescue. *Phytopathology*, 91(1), 111–116. doi: 10.1094/PHYTO.2001.91.1.111

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