

FOUNDATION FOR

ARABLE RESEARCH



Arable Research in Action

Wednesday 26 November 2025

FAR Arable Research Site

Chertsey

10:45am – 3:30pm

ARIA

Arable Research In Action

2025

ARIA



Arable Research In Action 2025

Health and safety

We trust that you will enjoy your day with us at ARIA; to assist us in ensuring your health and safety whilst on the property we ask that you both read and follow this information notice.

- All visitors are requested to follow instructions from FAR staff at all times.
- All visitors to the site are requested to stay within the public areas and not to cross into any roped off area.
- A hazard list is on display in the main marquee. Please read it and notify a FAR staff member if you have any concerns about one of the hazards listed, or if you see anything else that concerns you.

First aid

We have a number of First Aiders on site. Should you require any assistance, please ask a member of FAR staff. First aid kits are in the main marquee.

Rubbish

Rubbish bins are available for your use; we ask that you dispose of all rubbish considerately.

Vehicles

Vehicles will not be permitted outside of the designated car parking area.

Smoking

No smoking permitted inside any marquee.

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ARIA

Arable Research In Action 2025

On behalf of the Foundation for Arable Research, welcome to ARIA: Arable Research in Action, 2025.

We hope that you make the most of this opportunity to view a range of FAR trials and hear up-to-date research findings from New Zealand and overseas experts.

We have worked hard to create a programme covering a range of crops and management issues, and encourage you to participate fully in all discussions and deliberations. The aim of this day is to provide you with information and ideas that will help you to solve problems and create new opportunities in your cropping business. Presentation titles and speakers are outlined over the page, and summaries can be found further on in the booklet.

What's on?

The programme and map over the page outline the times and locations of all of today's presentations. Each speaker will give their presentation twice. Each talk is around 20 minutes long and will be followed by time for questions and discussion. There will also be the chance to talk to speakers at lunch time and at the end of the day.

Lunch

Lunch will be available from the large marquee after the morning presentations finish at 12:30pm. If you have dietary requirements please see a FAR team member.

Questions?

Should you require any assistance throughout the day, please don't hesitate to contact a member of the FAR team who will be more than happy to help.

We are confident that you will leave the event with new information to assist you in making critical farm management decisions and to improve the economic and environmental performance of your crop production system.

Enjoy your day.

The FAR Team

ADDING VALUE TO THE BUSINESS OF CROPPING



ARIA

Arable Research In Action 2025

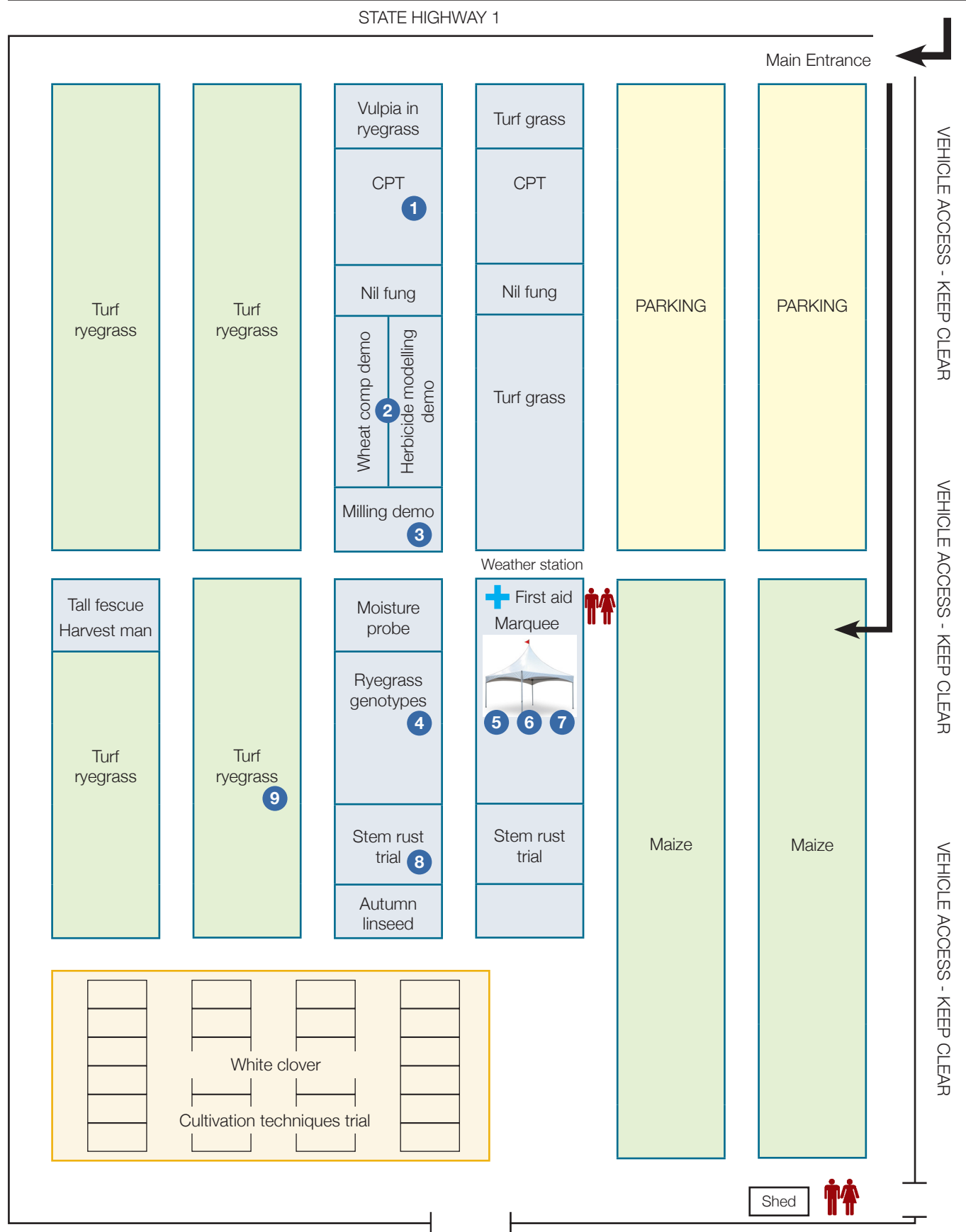
Programme and schedule

- 1. What really drives wheat yield?** - *Jacqueline Straathof, FAR and Mariana Andreucci, Lincoln University*
- 2. Weed management: know your numbers, control your weeds** - *Matilda Gunnarsson, FAR*
- 3. Growers to bakers: growing milling wheat crops that meet bakers' needs** - *Jo Drummond, FAR; NZFMA and BIRT*
- 4. Canopy management for ryegrass seed crops** - *Ben Harvey, FAR and Guilherme Barcellos, PGG Wrightson Seeds*
- 5. Portable sensor for rapid measurement of moisture content in grass seed** - *Nicole Anderson, Norwegian Institute of Bioeconomy Research*
- 6. Critical source areas on farms** - *Abie Horrocks, FAR and grower guests*
- 7. Functional biodiversity plantings** - *Paul Horne, IPM Technologies and Brad Howlett, BSI Plant & Food Research*
- 8. Ryegrass stem rust fungicide programmes** - *Nick Davies, BSI AgResearch and Richard Chynoweth, MRB*
- 9. Constraints on red clover seed yields** - *Sean Weith and Chris Smith, FAR*

10.45	11.00	11.30	12.00	12.30	1.30	2.00	2.30	3.00
Welcome	1	2	3	Lunch	1	2	3	Social
	6	5	8		6	5	8	
	9	4	7		9	4	7	



Site plan



What really drives wheat yield?

Mariana Andreucci, Lincoln University, Jacqueline Straathof and Jo Drummond FAR

Key points

- Irrigated Cultivar Performance Trial (CPT) wheat yields have increased from 10.4 – 13.8 t/ha since 2005 (approximately 170 kg/ha/year), but it is unclear whether this trend has continued since 2013-16.
- Dryland CPT yields have shown similar gradual yield improvements from 8.8 – 10.8 t/ha (approximately 100 kg/ha/year).
- Trends in other regions of the world indicate they are at or near a yield plateau.
- FAO data suggests on-farm yields in New Zealand are not keeping up with the genetic gains observed in CPT.
- Do we need to pay more attention to getting the foundations of yield right to realise potential?
- High yields can be achieved across a wide sowing window provided there are at least 600 heads/m² and 30,000 grains/m².
- Sowing date and cultivar affect how many tillers are produced, but only five tillers per plant survived to the end of the season.
- The earliest tillers are more important for producing yield than later tillers, therefore getting plant establishment right to support their development it is important.

Are we observing yield increases in New Zealand?

- Using 4-year means can account for seasonal variability and input differences, representing performance across a range of conditions, making underlying trends easier to see.
- Irrigated 4-year mean yields increased from 10.4 – 13.8 t/ha in Canterbury CPT, which corresponds to an annual increase of approximately 170 kg/ha/year (Figure 1, linear).
- However, there are questions as to how yields have changed since 2013-16.
- One interpretation is that there have been no yield improvements since 2013-16 (Figure 1, polynomial).
- Was the period between 2013-16 an outlier or was it due to an influx of new high-performing cultivars and chemistries that coincided with favourable environmental conditions?
- These scenarios raise the question, are we seeing incremental increase or have we reached the yield ceiling of our current cultivars and can we expect future incremental improvement to continue?
- Similar linear incremental changes have been observed in dryland CPT (8.8 – 10.8 t/ha), which corresponds to an annual increase of approximately 100 kg/ha/year (Figure 2).

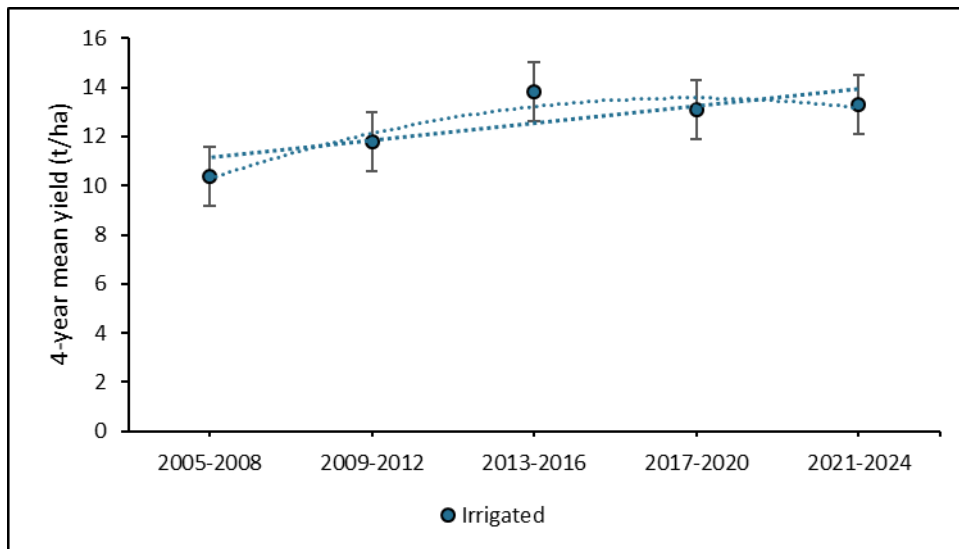


Figure 1. Four-year mean yield of irrigated autumn sown feed and biscuit wheat in Canterbury from 2005 – 2025 reporting different trend models (linear versus polynomial)

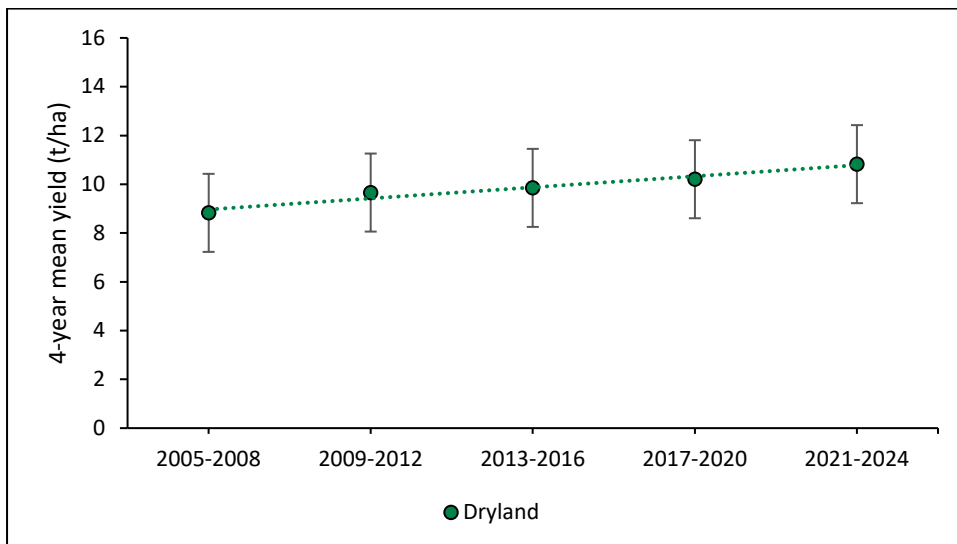
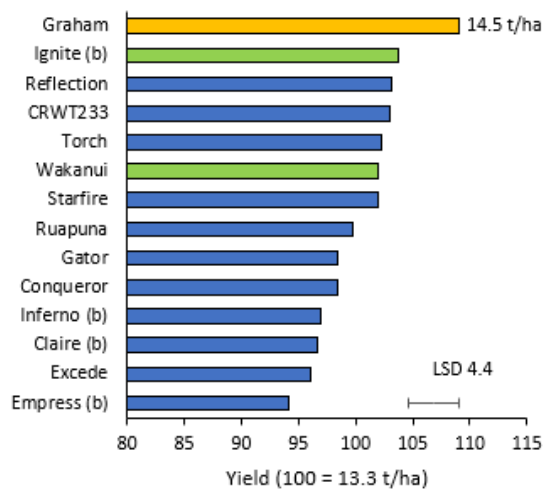


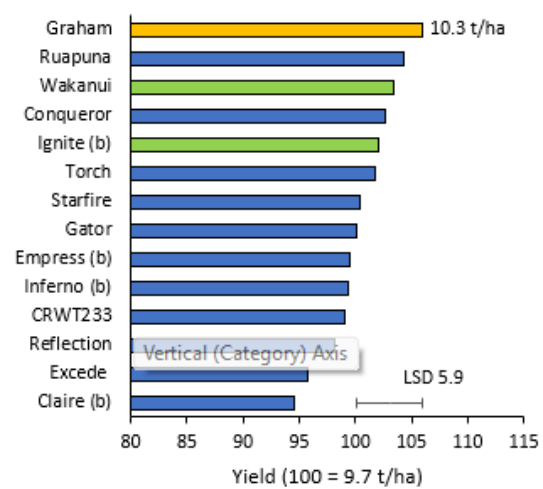
Figure 2. Four-year mean yield of irrigated autumn sown feed and biscuit wheat in Canterbury from 2005 – 2025.

Do new cultivars support yield increase?

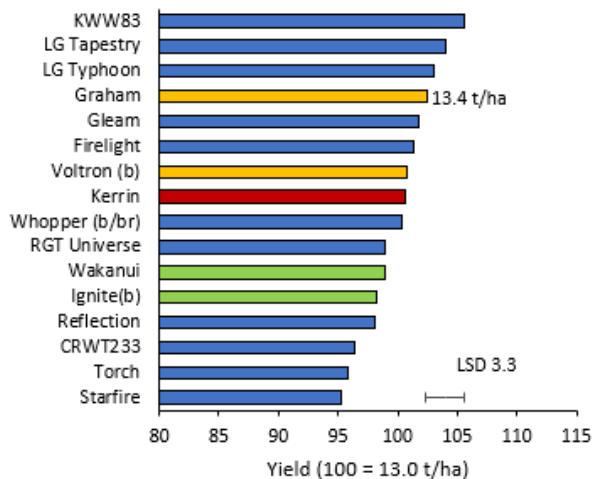
- The introduction of new cultivars has supported yield increase.
- An example of this is 'Graham', which was introduced to CPT in the 2010s.
- In irrigated trials, 'Graham' has declined in relative performance as newer cultivars have been introduced (Figures 3a, 3c and 3e).
 - 14.5 t/ha between 2013-16 (overall yield 13.3 t/ha)
 - 13.5 t/ha between 2017-20 (overall yield 13.0 t/ha)
 - 12.9 t/ha between 2021-24 (overall yield 13.0 t/ha)
- In dryland trials, the performance of 'Graham' has been stable (Figures 3b, 3d and 3f).
 - 10.3 t/ha between 2013-16 (overall yield 9.7 t/ha)
 - 10.7 t/ha between 2017-20 (overall yield 10.2 t/ha)
 - 10.5 t/ha between 2021-24 (overall yield 10.5 t/ha).



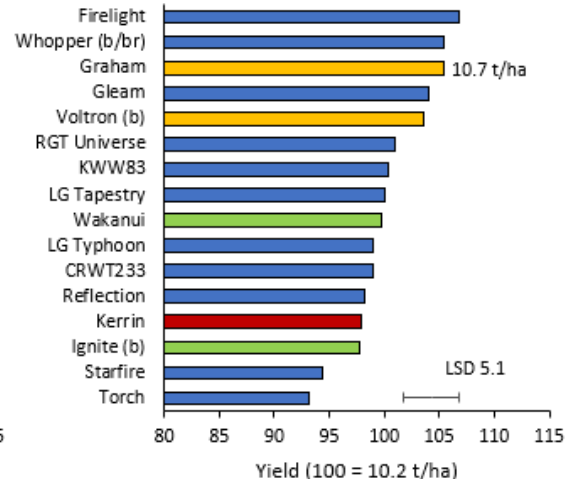
a. Irrigated: 2013-14 to 2016-17



b. Dryland: 2013-15 to 2016-17



c. Irrigated: 2017-18 to 2020-21



d. Dryland: 2017-18 to 2020-21

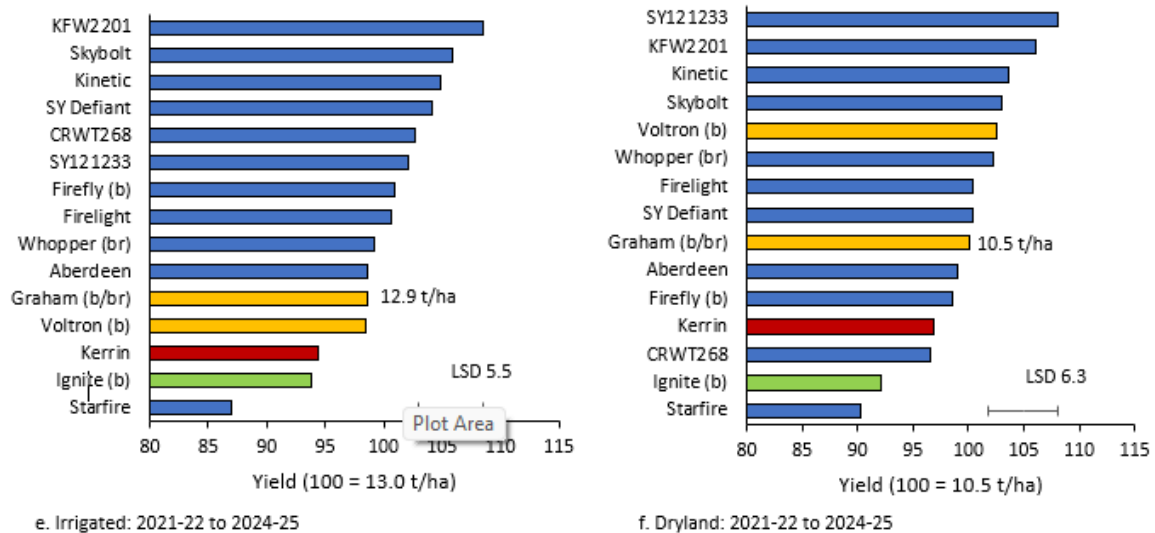


Figure 3a – f. 4-year relative mean yields for autumn sown feed and biscuit cultivars in Canterbury CPT under irrigated and dryland conditions. Recent standards, ‘Graham’ and ‘Voltron’ highlighted in orange; historic standards ‘Wakanui’ and ‘Ignite’ highlighted in green. ‘Kerrin’, used by Lincoln University highlighted in red. (b) = biscuit; (br) = bread

What does this mean on-farm?

- Long-term analyses in other regions of the world have predicted that they are at or near a yield plateau.
- Based on FAO data, New Zealand’s wheat yields achieved on-farm have increased over the same period by 90 kg/ha/year for combined irrigated and dryland crops.
- This suggests a disconnect between the yields achieved in CPT versus what happens on-farm.
- Do we need to pay more attention to getting the foundations of yield right to realise the potential of our current and future genetics?

Getting the detail right to improve on-farm yields: the importance of early tillers

A 3-year study at Lincoln University to understand yield components focused on detailed measurements of the number of tillers produced, the number of heads/m² and the number of grains/m² across a range of cultivars and sowing dates.

Cultivar x Sowing date

- Sowing any time between mid-February to mid-May can deliver yields of at least 15 t/ha (range 13.0 – 17.6 t/ha).
- Yields of 15 t/ha were achieved with around 600 heads/m² and at least 30,000 grains/m².
- Different cultivars had different strategies to achieve high yields; 'Kerrin' produced fewer but bigger heads/m², while 'Graham' produced a greater number of smaller heads/m².
- 'Kerrin's larger heads had in smaller grains, while 'Graham's smaller heads had larger grains.
- Increasing the number of grains/m² above 30,000 – 40,000 decreased thousand grain wheat, which can impact on final yield.

Tiller production

- Sowing date changed the total number of tillers produced per plant, but not the number of tillers at the end of the season (Figure 4).
- 'Graham' and 'Kerrin' produced more tillers from earlier sowing dates than 'Voltron', but not all of these tillers survived to the end of the season (Figure 4).
- Regardless of sowing date or cultivar or how many tillers were produced earlier in the season there were five tillers at the end of the season.
- Decisions on plant population matter, e.g. the high number of tillers that can result from a lower plant population are unlikely to survive to the end of the season.
- Tillers produced early were the most important for canopy closure and grain production.
- Supporting early tillers is important; heavy weed burdens can compromise these tillers, so weed control should happen early.
- There were no differences in survival of the main stem, however, a March sowing date demonstrated how a 20% loss of main stems can impact yield.
- There was no indication that grain numbers were reduced from sowing in March – May.

Harvest index (HI)

- Harvest Index is how much grain is produced in relation to biomass.
- From individual plants, HI has a ceiling around 55%.
- To overcome the individual plant ceiling, we can work on smaller individual plants in a dense community – yield then becomes about heads/m² rather than individual plants.

Grain filling – 'Graham'

- It took 380°Cd (growing degree days) from flag leaf to the maximum growth rate.
 - This means that at an average of 15°C, within 25 days of flag leaf expansion, grain filling will be determined.
- It took 745°Cd from flag leaf to physiological maturity (end of grain filling).
 - This means at an average of 15°C, grain filling will be complete in 50 days.
- Understanding the time from flag leaf to the start and finish of grain fill can help with irrigation and harvest scheduling.

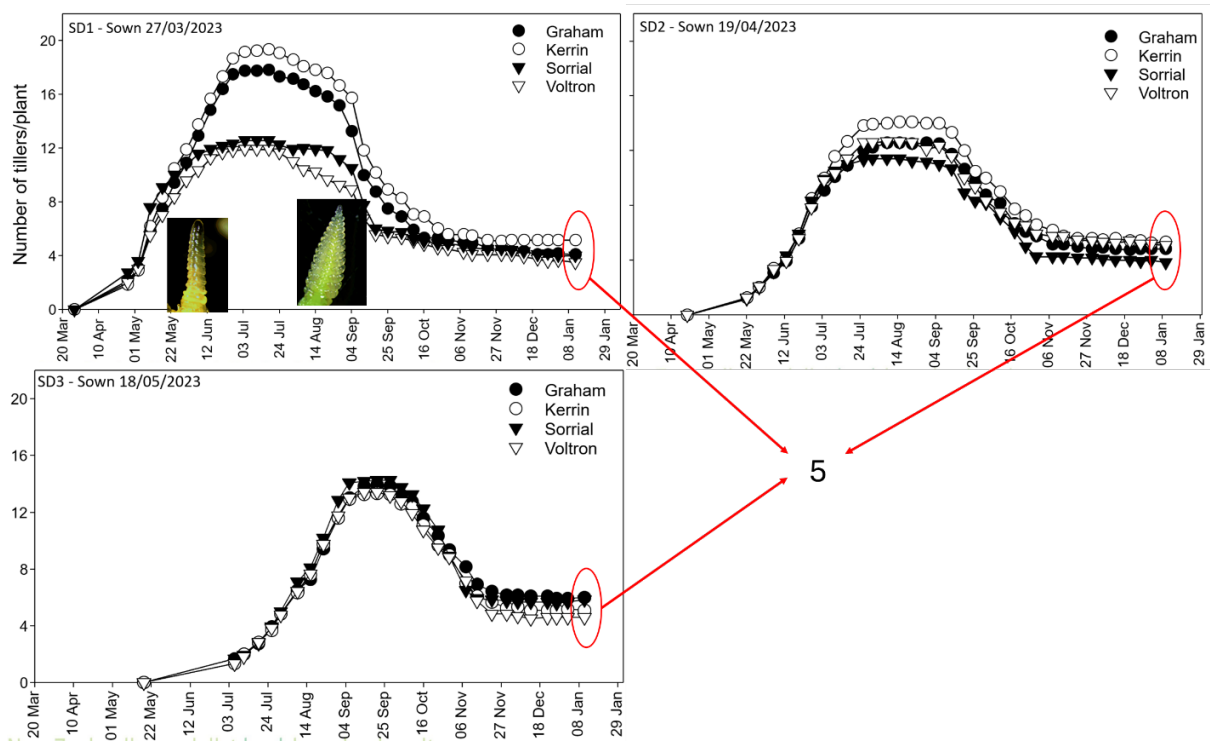


Figure 4. The number of tillers produced by autumn sown wheat cultivars Graham, Kerrin, Sorrial and Voltron from three sowing dates, 27 March 2023, 19 April 2023 and 18 May 2023. Courtesy of Mariana Andreucci, Lincoln University.

Contact: Jacqueline.Straathof@far.org.nz

Weed management: know your numbers – control your weeds

Matilda Gunnarsson (FAR)

Key points

- Stopping weeds from setting seed is the most important component of weed management.
- Without selection pressure it is very uncommon for a weed to be resistant to more than one herbicide.
- Repeated use of the same herbicide group, even in different crops, quickly selects for resistant weeds
- Group 2 herbicides (ALS inhibitors) are a good example of how easy it is to overuse one mode of action (MoA) group. Resistance to this chemistry is now widespread in New Zealand arable systems

Integrated weed management: Making it work on your farm

There are lots of ways to bring integrated weed management (IWM) into your system; it doesn't have to happen all at once. Start small by trying a couple of new practices, for example increased sowing rates or including a crop you haven't grown before. From there, you can build on what works and add more tactics over time.

After a few seasons, you'll have a system where different weed control tools work together; herbicides, crop competition, cultivation, and timing all playing their part. Using a mix of approaches takes the pressure off any one tool, helping keep them effective for the long term. The key is to keep weeds guessing; a diverse, flexible approach stops them from adapting and keeps your weed control working year after year.

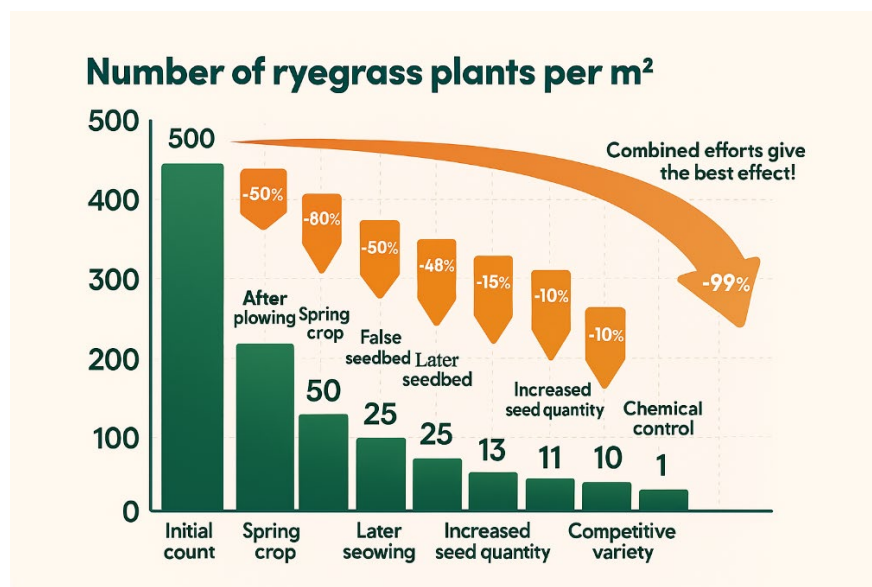


Figure 1. A number of IWM measures reduce the population of Italian ryegrass in wheat, thereby significantly lowering the risk of resistance development. The numbers in the arrows indicate the expected effect of each individual measure. Source: translated from original, Seges Innovation 2021

Figure 1 (above) shows a number of integrated weed management practises and how, together, they can achieve good levels of control. This figure shows what happens when spring cereals are established after ploughing, and when the illustrated measures are implemented in the subsequent winter wheat crop. A competitive wheat variety is sown late, with a high seed rate following a false seedbed.

Know your groups – protect your future

Knowing what herbicide mode of action (MoA) groups you are using across the rotation is key to keeping weed control options effective for the long term. Herbicide products are classified and grouped according to their mode of action i.e. herbicides that target the same lethal pathway are grouped together. Repeated use of the same herbicide group, even in different crops, quickly selects for resistant weeds.

Group 2 herbicides (ALS inhibitors) are a good example of how easy it is to overuse one chemistry group in arable systems. It is also the group with by far the largest number of resistant weeds in New Zealand and worldwide. These products are widely used because they target many weed species and can be used in many crops. Group 2 herbicides are used in cereals, clover, maize, lucerne, peas and pasture. Group 2 herbicides are also used in some herbicide-tolerant forage brassicas.

Strength in numbers: Crop diversity wins

The "number" of crops, i.e. a longer rotation with more diversity, is a key factor for weed management. A diverse rotation with more crop types and different growth habits disrupts weed cycles and limits their ability to thrive. It also allows us to implement more diverse control methods. Herbicide rotation is a proven tactic that delays the onset of herbicide resistance because each mode of action is used less frequently. This strategy relies on having a diverse crop rotation, which, in turn, allows the use of different herbicide groups.

Keep the weed seed bank numbers low

Stopping weeds from setting seed is the most important part of weed management. Keeping seed return low not only reduces the risk of herbicide resistance developing, but also limits competition with the crop, leading to better yields. If early control hasn't gone to plan, there are still ways to prevent seed rain before harvest. Options like cutting weedy areas for silage, roguing out patches, or spot-spraying small infestations can make a big difference. Every seed you stop from going back into the soil helps keep future weed pressure, and resistance risk, in check.

STOP, SLOW, GO – Know your resistance risk

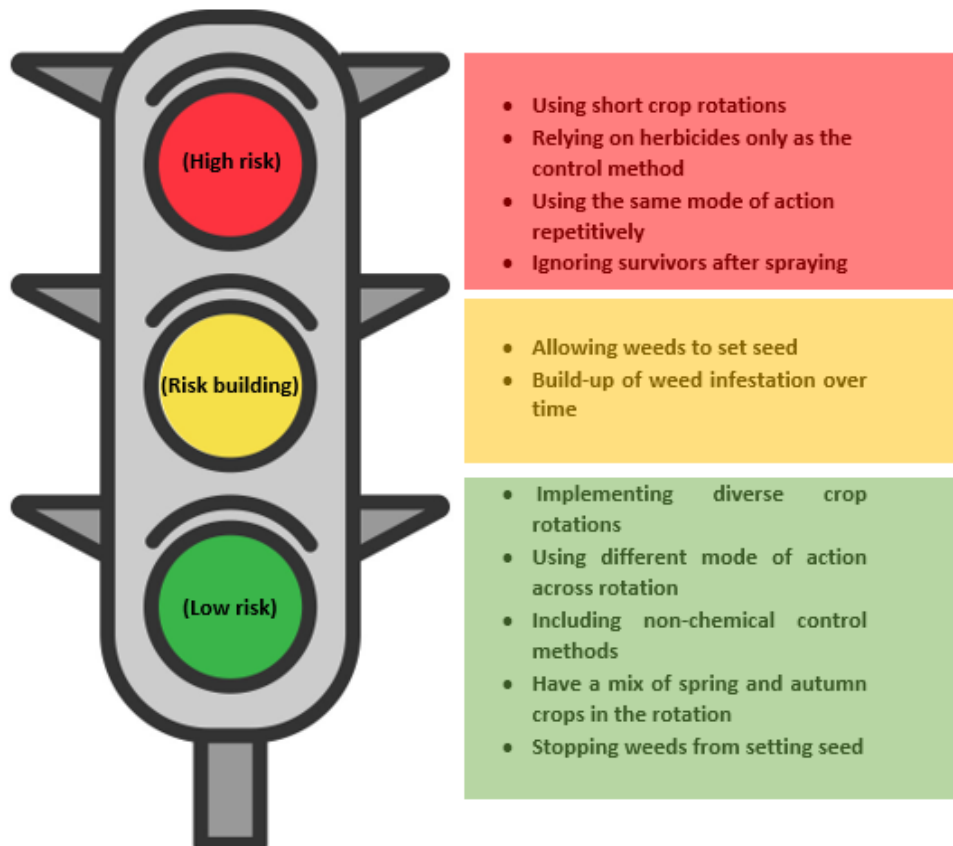


Figure 2. Traffic light system showing the risk of developing herbicide resistance based on management practices.

References

https://www.landbrugsinfo.dk/public/b/d/0/plantebeskyttelse_italiensk_raigras_bekampes_med_ipm#:~:text=Italiensk%20raigr%C3%A6s%20skal%20bek%C3%A6mpes%20med%20IPM.

<https://www.weedsmart.org.au/content/when-to-mix-and-when-to-rotate/>

Acknowledgement

This work is funded by MPI's Primary Sector Growth Fund, supported by SIRC and Vegetable Research and Innovation.

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Growers to bakers: understanding grain, milling and baking quality.

Jo Drummond (FAR), Phil Jackson (NZFMA) and Ralph Thorogood (BIRT)

Key points

- Grain quality drives milling potential. Dense, well-filled grains with low screenings and high protein quality work well for milling.
- Protein content supports dough strength and volume, but protein quality and the ratio of glutenin to gliadin determines the elasticity and extensibility.
- Tools like the farinograph and extensograph measure dough strength, water absorption and extensibility.
- The Baking Industry Research Trust (BIRT) bake test goes further by simulating actual baking conditions, helping growers and millers assess flour functionality more accurately.

FAR's *Growers to Bakers* programme aims to bridge the gap between growers, millers and bakers by investigating the use of the BIRT bake test alongside farinograph and extensograph testing across a range of cultivar and management regimes. It includes the development of updated agronomic nitrogen (N) management strategies to support optimal milling and baking quality.

Grain quality in milling wheat refers to traits that influence flour yield and baking performance.

Key indicators include:

- **Test weight:** density. Higher values suggest better flour extraction.
- **Falling number:** Indicates sprouting damage; low scores mean high alpha-amylase, which harms bread structure and cannot be corrected.
- **Grain protein content:** Calculated from nitrogen ($N \times 5.7$), grain protein content affects dough strength, water absorption, and baking characteristics. However, **protein quality**—the balance of glutenin and gliadin—is just as important as **quantity** for breadmaking performance.
- **Thousand grain weight:** Used for determining milling potential and calculating sowing rates.
- **Screenings:** High levels of screenings can reduce the usable grain portion, lowering flour extraction and quality.

All of these traits are influenced by environmental conditions, cultivar choice, and nitrogen management.

Milling quality refers to how efficiently wheat grain can be processed into flour. Key traits include:

- **Flour protein:** Glutenin and gliadin form gluten when mixed with water. The ratio affects dough strength and extensibility (stretch). Removal of the bran layers during milling can result in flour protein being lower than grain protein.
- **Particle size index (PSI):** Indicates kernel hardness. Harder wheat absorbs more water and suits breadmaking.
- **Colour grade:** Is a measure of flour whiteness. It is influenced by bran content and milling efficiency.
- Millers blend wheat to meet specific flour requirements, and quality traits help determine suitability for different end uses.

Baking quality measures how well flour performs in recipes, especially bread. It is influenced by:

Protein content and quality: Affects dough elasticity, gas retention, and final product texture.

Farinograph testing: Assesses water absorption, dough development time, and stability.

- Water absorption is the amount of water required to hydrate flour to a consistent firmness. It is the percentage of flour weight and is measured when the farinograph reaches 500 Brabender units (BU) (Figure 1).
- Development time is how long it takes for dough to reach maximum viscosity before gluten starts to break down. It is measured from the start of mixing to when the graph reaches 500 BU (Figure 1).
- Stability denotes how well dough can withstand mixing stress. It is measured from when the graph reaches 500 BU until when it leaves the 500 BU line (Figure 1).

Extensograph testing: Measures dough resistance, extensibility, and energy to predict loaf volume and crumb texture.

- Balance between strength and stretch indicates a well-rounded dough that is suitable for multiple end uses (Figure 2a).
- Dough can be too rigid, with too much resistance and not enough stretch (Figure 2b).
- Dough made from flour that is too weak can be soft and slack (Figure 2c).

BIRT bake test: A real-world baking simulation developed in New Zealand to better predict flour performance across cultivars and management regimes.

When protein/resistance is too strong, bakers can have difficulty developing the dough (Figure 3). This leads to product faults in the bakery, like holes and blisters on buns (Figures 4-5). Bakers are learning to use more dough relaxants in their formulations to help alleviate these issues, but they are not a cure all. For example, last season a very strong batch of flour led to specification changes to help in the bakery.

Balanced dough strength and extensibility are key to producing high-quality baked goods.

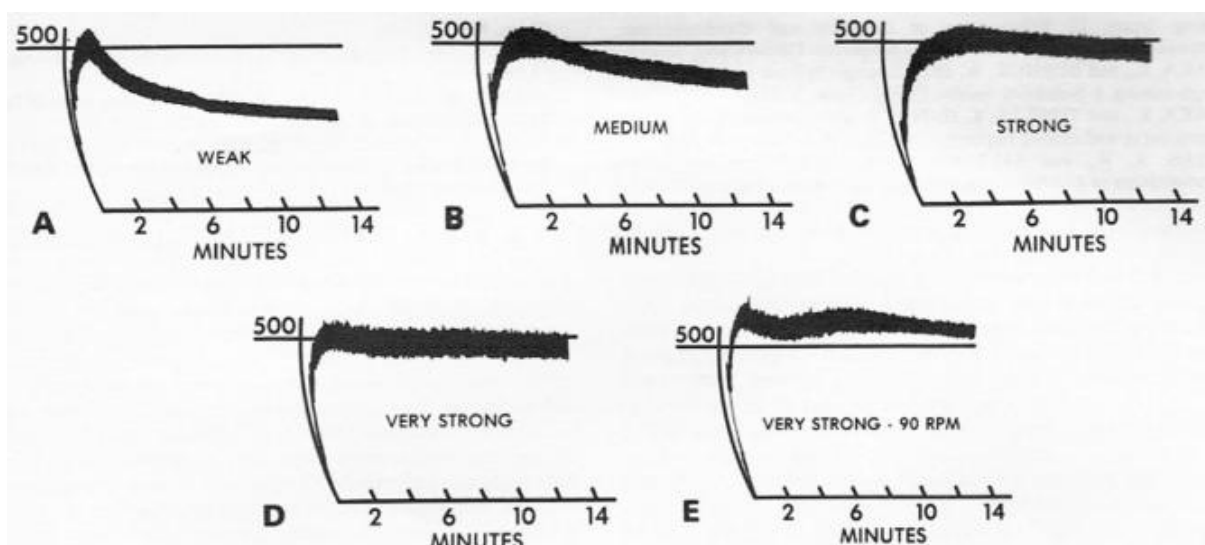


Figure 1. Examples of farinograph dough curves. Source: Don and Bock (2022).

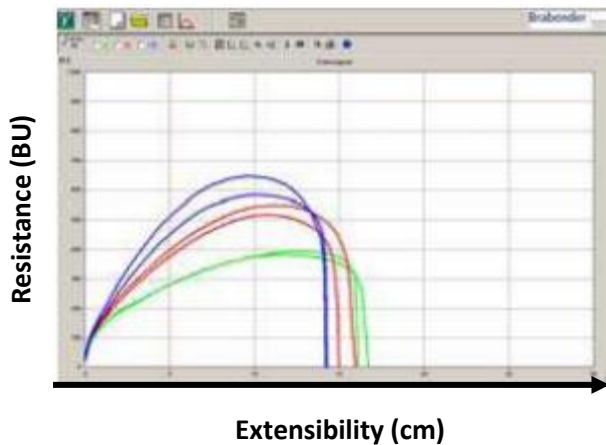


Figure 2a. Strong flour, extensible, elastic dough

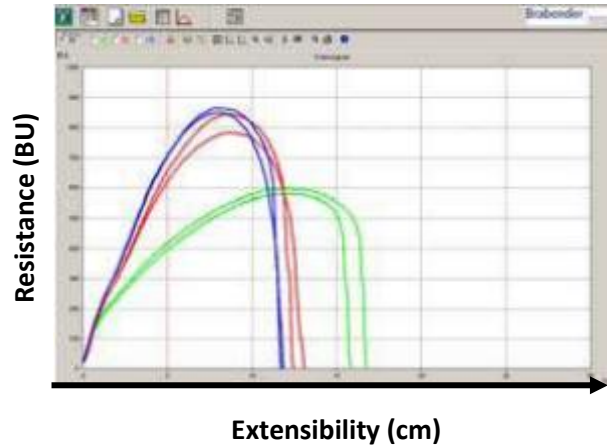


Figure 2b. Rigid dough, poor extensibility

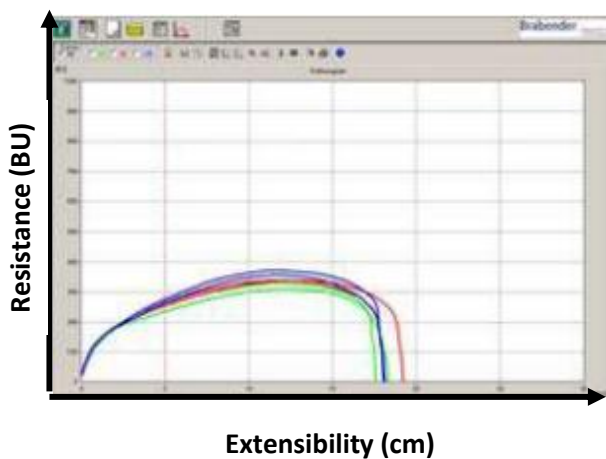


Figure 2c. Weak flour, soft, slack dough

Source: Flour reports and testing, BIRT (2023).

References

BIRT (2023). Flour reports and flour testing. <https://www.bakeinfo.co.nz/wp-content/uploads/2023/04/BIRT-Flour-Testing-Information-edited-April-2023.pdf>

Don, C (2022). Chapter 4 – Dough rheology and the Farinograph: The mechanism underlying dough development. The Farinograph Handbook (Fourth Edition), Bock, J, E, and Don, C (Eds). Woodhead Publishing. Pages 43-70. <https://doi.org/10.1016/B978-0-12-819546-8.00015-7>.

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Acknowledgements



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Flour Report - Information

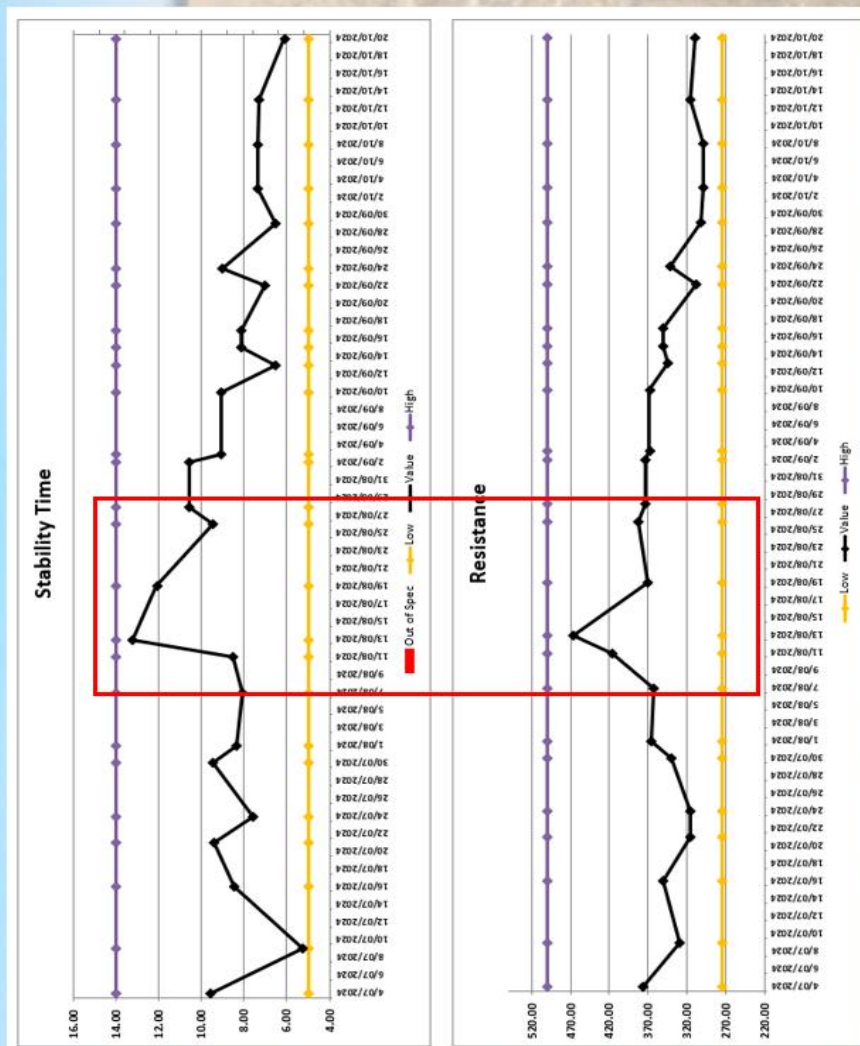


Figure 3. Flour report information. Courtesy of Ralph Thorogood - BIRT.

Product Faults

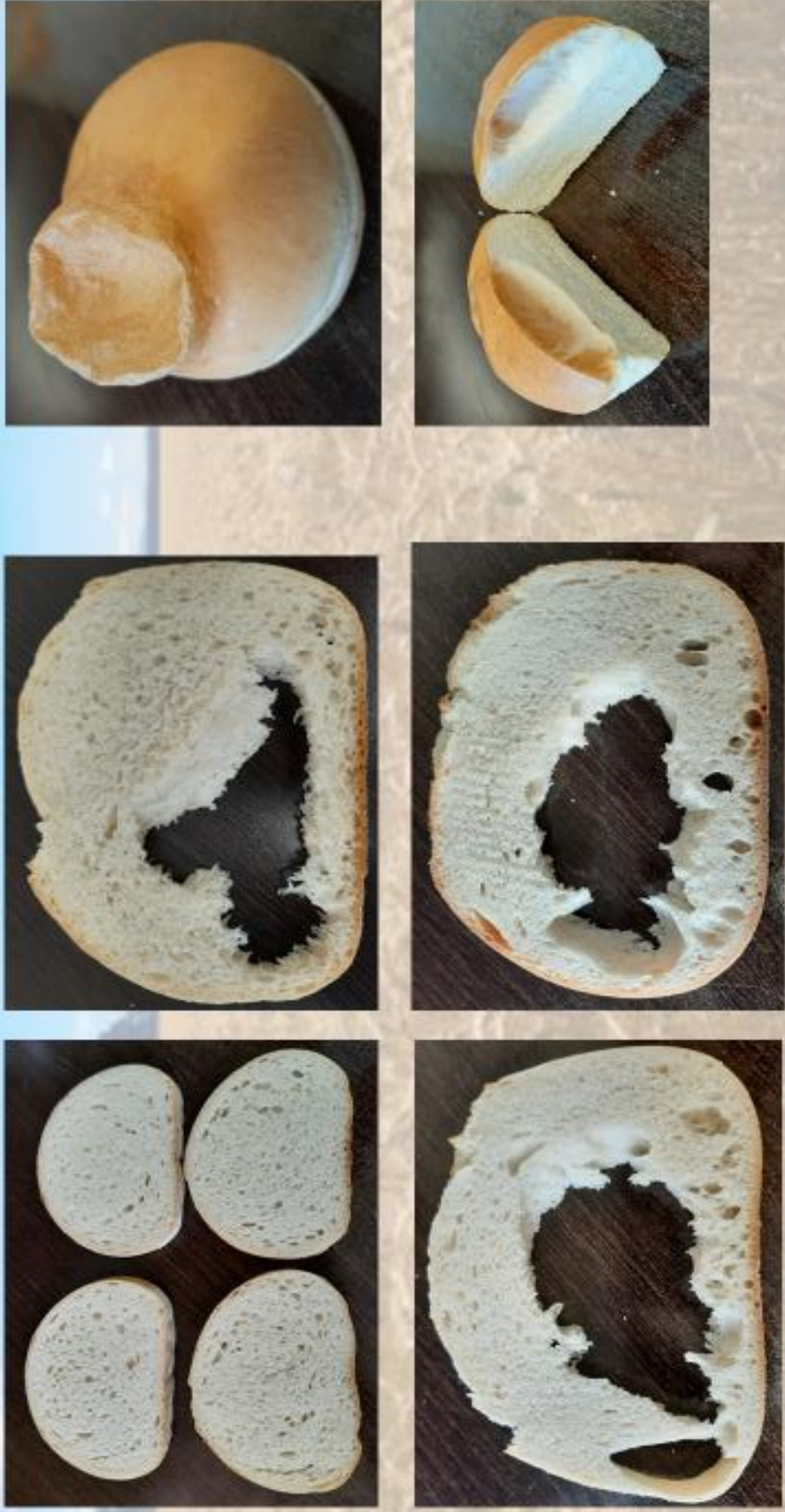


Figure 4. Examples of product faults. Courtesy of Ralph Thorogood - BIRT.

Product Faults



Figure 5. Product faults. Courtesy of Ralph Thorogood – BIRT.

Canopy management for ryegrass seed crops

Ben Harvey, FAR and Guilherme Barcellos, PGG Wrightson Seeds

Key points

- Some newer, late-flowering, perennial ryegrass cultivars require different management from older cultivars to achieve maximum seed yield.
- In a 2024-2025 trial, close grazing through late winter and spring increased seed yield, although this effect may have been reduced due to late sowing.
- Earlier closing dates gave greater seed yields than either standard or late closing dates.
- Further research will investigate the effects of closing date and plant growth regulator rate.

Background

Many newer forage varieties of perennial ryegrass are bred to have excellent summer forage quality, while older varieties may continue to produce (less palatable) reproductive tillers after the first spring flush (“aftermath heading”, AMH). Quality summer forage is a very desirable trait in a pasture, where reproductive stems serve no purpose, but is also useful in a seed production system, if the stand is to be used for post-harvest grazing. However, from a seed production perspective, this decrease in reproductive tillers, appears to be linked to a reduction in seed yield.

Low aftermath-heading varieties of perennial ryegrass such as ‘Three60’ (PGGWrightson) and ‘Array’ (Barenbrug) are bred by selecting for, among other traits, drought tolerance and persistence. In practice, these varieties often exhibit a higher number of “false nodes” that develop in tillers through spring as the plants move into stem extension. In a grazing system, these nodes can form on ‘stoloniferous’ tillers that can move across the ground. Roots are able to form at the nodes, meaning that if conditions (such as drought) lead to the parent plant dying, the rooted tillers will survive and persistence will be improved. In a seed production system, however, these false nodes can lift the growing point above the grazing (or topping) level, resulting in the possibility of the growing point being removed during a grazing (or topping) event, or at closing. Low AMH cultivars appear unable to produce new reproductive tillers from the nodes that remain after the growing point is removed, resulting in fewer seed heads and lower seed yields than conventional cultivars.

Efforts to improve seed yield in low aftermath-heading varieties have focused on grazing management and closing date. Growers have found some success in keeping paddocks grazed (e.g. by set-stocking) over winter and spring. This allows light into the base of the plant, which can stimulate the production of more tillers that may be able to go reproductive and form seed heads. It could also be that it prevents the growing points from being raised up to grazing or topping level by the false nodes, allowing these tillers to retain the potential to become reproductive.

2024 Trial – Chertsey

In the 2024-2025 season, FAR conducted a trial investigating the effect of grazing regimes and closing date on seed yield in three low-AMH perennial ryegrass varieties: ‘Three⁶⁰’, ‘Array’ and ‘Legion’. An older, non-low-AMH variety, ‘One⁵⁰’, was included as a comparison. The trial was planted on 2 April, 2024 at Chertsey, Mid-Canterbury. Grazing was simulated on the trial with a ride-on mower. The whole trial was ‘grazed’ to even up the plots on 30 August, 2024. Plots were then grazed regularly until closing, except for one plot of each cultivar in each replicate, which was left ungrazed until a final topping at closing. Closing dates were varied as per Table 1.

Table 1. Closing date treatments for a ryegrass seed yield trial carried out at Chertsey in 2024.

Cultivar	Heading date relative to 'Nui'	Closing date	Actual closing date
One⁵⁰	+20 days	Early	October 16
		Standard	October 29
		Late	November 9
Three⁶⁰	+20 days	Early	October 16
		Standard	October 29
		Late	November 9
Legion	+13 days	Early	October 4
		Standard	October 16
		Late	October 29
Array	+23 days	Early	October 16
		Standard	October 29
		Late	November 9

All plots were given standard fertiliser, fungicide and herbicide regimes for a ryegrass seed crop and plots were individually harvested between 22 January and 14 February, 2025. Results are shown in Table 2.

Table 2. Results of a trial investigating the effects of closing date and grazing management on four cultivars of perennial ryegrass at Chertsey in the 2024-2025 season. Seed yield values are shown after machine dressing. Seed yield values followed by the same letter are not significantly different from each other.

Cultivar	Grazing Management	Closing Date	Seed head density (Heads/m ²)	TSW (g)	Seed yield (kg/ha)
One⁵⁰	None	Standard	1586	1.59	1048 de
	Regular	Early	2252	1.58	1651 ab
	Regular	Standard	2492	1.60	1331 c
	Regular	Late	2540	1.46	1197 cd
Three⁶⁰	None	Standard	1447	1.56	779 fg
	Regular	Early	2496	1.70	1231 c
	Regular	Standard	2363	1.72	883 efg
	Regular	Late	1795	1.59	762 g
Array	None	Standard	1294	1.73	1014 e
	Regular	Early	1813	1.80	1717 a
	Regular	Standard	1294	1.85	1051 de
	Regular	Late	1402	1.58	931 efg
Legion	None	Standard	2363	1.56	1201 cd
	Regular	Early	2737	1.79	1585 ab
	Regular	Standard	2935	1.62	1525 b
	Regular	Late	2085	1.73	950 efg

The highest seed yield for each cultivar was achieved with the earliest closing date. This aligns with industry information that suggests bringing closing forward 5-10 days from what would be calculated using the heading date. Seed yield was not significantly correlated to either seed head density or thousand-seed weight. Measurements of stem length, spikelet number, floret number and floret site utilisation (data not shown) also showed no discernible pattern.

Most cultivars showed a strong positive correlation between regular grazing and increased head numbers (almost double for 'Three⁶⁰', for example). This result backs up the theory that reproductive growing points are being removed when the crop is closed after not being grazed through late winter and spring. While not as pronounced as the effect of grazing on head numbers, seed yield was also significantly increased by regular grazing. Interestingly, this was also observed in the older cultivar ('One⁵⁰'), which showed a 27% increase in seed yield in the grazed plots compared to the ungrazed. This is compared to the low-AMH varieties which gave yield increases of 27%, 13% and 4% for 'Legion', 'Three⁶⁰' and 'Array', respectively. The reasons for these results are unclear and could warrant further study to try to ensure that the increase in seed head numbers is translated into higher seed yields.

2025 trial – Chertsey

Building on from last year's work, the current trial will focus on the effect of different closing dates, while also investigating plant growth regulator (PGR) rates. One reason not to close earlier than recommended is to prevent lodging, so the thinking is to reduce lodging in earlier-closed ryegrass seed crops using higher rates of PGR. To allow a greater number of closing date and PGR treatments, the 2025 trial has focused on just two cultivars, a control variety, 'One⁵⁰', and a low-AMH variety, 'Three⁶⁰'. A third trial is scheduled to be planted in 2026, details to be determined at a later date.

Acknowledgement

This work is supported by the Seed Industry Research Centre.

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Portable sensor for rapid measurement of moisture content in grass seed

Nicole Anderson, Norwegian Institute of Bioeconomy Research and Jing Zhou, Oregon State University

Key points

- Measuring seed moisture content (SMC) in ryegrass is time consuming and prone to error.
- A portable sensing device using near-infrared (NIR) spectroscopy principles is being developed (Grady Sensor).
- Testing results indicate it is a reliable replacement for the traditional oven drying method.
- The Grady Sensor is now publicly available in Oregon and will be available worldwide soon.

Seed moisture content (SMC) is the most reliable indicator of optimal harvest timing in many seed crops, including grass seed. Measuring SMC as grass seed crops approach maturity is recommended to determine optimal harvest timing. Currently, to measure SMC, seeds need to be stripped from heads by hand, weighed, dried until all the moisture has been lost, then re-weighed, and SMC manually calculated. Collecting SMC information in this manner is arduous, time consuming, and prone to error. Consequently, this procedure has resulted in inadequate SMC testing or failure to test in a timely fashion. In addition, SMC is an important factor in the storage of harvested seed, which typically needs to be stored under 12% SMC, to ensure high seed quality. The goal of this project is to develop a portable sensing device - The Grady Sensor - that allows for rapid and accurate SMC measurement of grass seed.

The sensor employs near-infrared (NIR) spectroscopy principles that water molecules absorb specific NIR wavelengths. By analysing the light reflected from the seed surface, the sensor predicts SMC based on the intensity of the reflected light at moisture-sensitive wavelengths. Over two years, multiple sensor prototypes have been developed, and their performance has been validated through field tests in Oregon and New Zealand.

Sensor readings were compared to laboratory oven gravimetric SMC values of samples collected from major grass seed species, including tall fescue [*Schedonorus phoenix* (Scop.) Holub], annual ryegrass [*Lolium perenne* L. ssp. *multiflorum* (Lam.)], perennial ryegrass (*Lolium perenne* L.), orchardgrass (*Dactylis glomerata* L.), Kentucky bluegrass (*Poa pratensis* L.), creeping red fescue (*Festuca rubra* L. subsp. *rubra*), Chewings fescue [*Festuca rubra* L. subsp. *fallax* (Thuill.) Nyman], and creeping bentgrass (*Agrostis stolonifera* L.).

The sensor readings demonstrated a significant linear relationship with the oven SMC (Figure 1). Mean absolute errors of sensor SMC predictions were within 1.2 to 4.6% across all grass species. The results indicate that the prototype is a reliable replacement for the traditional oven drying method. The Grady Sensor is now publicly available in Oregon and will be available worldwide soon.

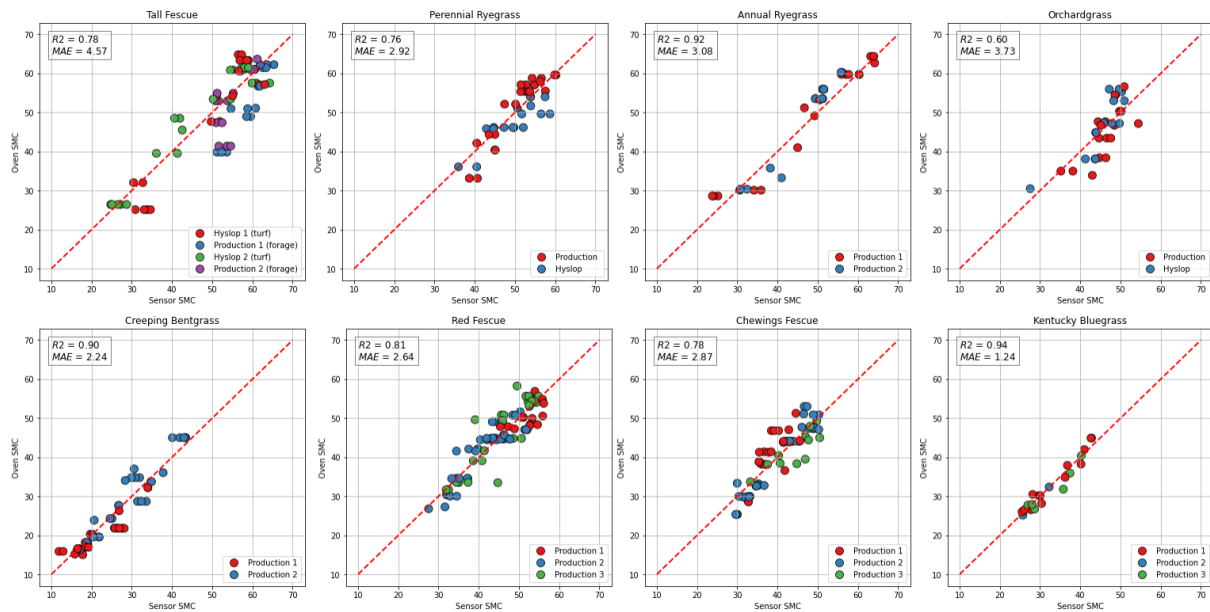


Figure 1. Scatterplots showing the relationship between near-infrared (NIR) sensor seed moisture content (SMC) and laboratory oven-derived SMC for tall fescue, perennial ryegrass, annual ryegrass, orchardgrass, creeping bentgrass, creeping red fescue, Chewings fescue and Kentucky bluegrass. For each grass species, training data from all sampled varieties were combined and used to establish estimation equations.

Managing runoff - Farmer to farmer learning

Abie Horrocks (FAR) and Peter Mitchell (North Otago arable farmer)

Key points

- Managing runoff and critical source areas (CSA) on arable farms requires site-specific mitigations. A one-size-fits-all approach is not effective due to variability in soil types, cropping systems and environmental conditions.
- Farmer to farmer learning shows how farmers with different motivations and approaches can head in the same direction. The focus is not on rules, but on learning from each other and doing what makes sense.
- Through farmer to farmer learning, growers share what works in their own systems, helping others identify effective, realistic strategies for managing runoff and reducing soil loss.

Critical Source Areas (CSAs) on cropping farms are specific locations where sediments and nutrients are at risk of being transported to water bodies (Table 1). Think of areas where, during rainfall events, soil is most susceptible to entering a flow path to a water body. Even if there is not connectivity to water bodies it makes good sense to keep soil in the paddock. The extent to which soil loss may occur is influenced by factors both in and out of your control (Table 1). For example, both saturation and compaction can lead to surface water pooling, increasing the risk of sediment run-off. Saturation is largely out of your control as it is determined by inherent soil properties and rainfall whereas compaction can be managed on farm.

Table 1. Example of critical source areas (CSAs) and factors that influence run-off on cropping farms.

Examples of CSAs on cropping farms	Factors that influence run-off
Stream banks and riparian zones	Slope (length and grade)
Slopes	Soil vegetation cover
Poorly drained or compacted soils	Intensity and volume of rain
Compacted tracks that create overland flow pathways	Soil physical properties - compaction, infiltration rate
Permanent drainage ditches or tile drains	Management choices
Low depressions or swales	Tillage choices
Ephemeral streams	Grazing strategies

In 2023, FAR received funding from the MPI Accelerator Fund to address the lack of cropping-specific guidance for managing CSAs on arable farms. Because CSAs require site-specific mitigations, a flexible approach based on appropriate risk assessment is likely to achieve the best environmental outcomes. Farmer knowledge of their land is key, so an important aim of the project was to facilitate farmer to farmer learning. Case studies of farmers who have developed and implemented their own solutions are being collected and will be a cornerstone of the guidelines.

Farmer to farmer learning works well because it builds on farmers' own motivations and experiences. Everyone interviewed has developed their approach to managing their CSA, but they share a common drive to do things that make good sense, not just because they're told to. Intensive mixed cropper Tim Gorton's Manawatu farm borders a river and has multiple water pathways. One

of the mitigations he has implemented is fencing off steep unproductive areas where water tends to run, carrying sediment with it (Figure 1).

The grass in these fenced areas slows water flow and allows soil to settle. Native plantings further enhance this by stabilising the soil and providing nectar for beneficial predators and parasitoids that help control pests in his crops.

Tim's advice: *don't try to do it all at once, tackle it in bite-sized pieces.*



Figure 1. Fenced off area where the grass and biodiversity planting help filter out sediment during periods of high rainfall (Manawatu).

Andrew Darling, is another case study farmer who farms a flat to intensive rolling farm in South Canterbury. His farm features ephemeral waterways and areas where water pools. "Water pooling on the surface results in crops not growing well and where crops don't grow well it becomes a source of sediment and weeds." In 2024 a section of a low-lying ephemeral area that can flow in winter was planted in two *Carex* (grass) varieties (Secta and Geminata) (Figure 2). "The aim is to see which will be the most suitable for our ephemeral water course. Now that I have started on this path the more I notice new opportunities like unproductive areas or corners".



Figure 2. Trial planting of two species of carex in an ephemeral stream area (South Canterbury).

In this talk, North Otago mixed cropping and livestock farmer Peter Mitchell will share his experience managing CSAs. One of his focuses has been getting drainage right. Above ground he has contoured gentle bunds to direct surface water to drains or creeks at the edges of paddocks to reduce surface flows and scouring which takes valuable soil off the paddock. "The first part is identifying what the problem is and then asking how can I solve it? Specifically, where the water comes from, and where it goes versus where it should go."

Acknowledgement This work is funded by the MPI Accelerator Fund.

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Functional biodiversity plantings

Brad Howlett (BSI, Plant & Food) and Paul Horne (IPM Technologies- Australia)

Key points

- Many native plants can support a diversity of beneficial insects that improve pollination and suppress pest populations on arable farms.
- Including plant species that flower at different times in on-farm biodiversity plantings can provide continuous support for beneficial insects, such as hoverflies, throughout the season.
- Research has shown that the number insect pollinators associated with native plant species is much higher than previously recognised. Using biodiversity plantings to support a greater range of pollinators is expected to enhance both the efficiency and resilience of pollination.
- The ability to gain value from beneficial insects depends on the selectivity of insecticides used, as insecticide choice significantly affects the diversity and abundance of both micro and macro invertebrates in crops.

Adding biodiversity plantings doesn't mean losing productive land. There are often more location options than you might think; for example, riparian areas, areas out of production, unproductive zones or awkward corners. Often, the hardest part is often knowing where to start. Be clear about your purpose. This may be shelter, erosion control, aesthetics, social licence to operate, or increasing resilience by supporting beneficial insects such as pest predators or pollinators.

Here at Chertsey, our purpose was to support a diversity of beneficial insects to enhance pollination and suppress pests such as aphids. Greater pollinator diversity has been linked to increased crop yields and improved yield stability. Similarly, diverse communities of natural enemies can improve pest suppression. For example, plantings which provide a continuous nectar supply can boost biological control by increasing the flight capacity, life-span, and host-searching range of parasitoids.

Plant & Food Research received funding from the Ministry for Primary Industries Sustainable Food and Fibre Futures (SFFF) in 2021 for a project called *Beneficial Biodiversity for Greater Good - designing native plantings for beneficial insects*. The aim of this project was to gain a better understanding of which insect species are supported by native plantings. The work has found that the association between insect pollinators and native plant species is much higher than was previously documented, and has provided valuable insights into which beneficial insect species visit different native plants. This knowledge will inform practical guidelines for designing on-farm native plantings that include a variety of flowering species to ensure a continuous food supply for insects (Table 1). In this session Brad Howlett will share results from this work.

He will be followed by Paul Horne, providing insights into how to make the most of beneficial insects. Beneficials such as hoverflies, brown lacewings and wasps that parasitise aphids and caterpillars can substantially reduce pest populations. They require access to pollen and nectar, but their contribution will depend on the insecticides applied. Not all insecticides are equal, some are highly toxic to beneficial species, while others are relatively safe. Paul will discuss these differences and their implications for integrated pest management (IPM). Information on the impact of insecticides on beneficial species is available online from several sources, including the GRDC/CESAR (<https://cesaraustralia.com/resources/beneficials-toxicity-table/>) in Australia and IPM Technologies (<https://ipmtechnologies.com.au/#effects>).

Table 1. Flowering periods of different native plant species observed within native plantings across the Canterbury Plains.

Plant name			Spring			Summer			Autumn			Winter		
Māori	European	Species	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Tarata	Lemonwood	<i>Pittosporum eugenoides</i>												
Kōwhai	Weeping kowhai	<i>Sophora microphylla</i>												
Korokio	Wire-netting bush	<i>Corakia cotoneaster</i>												
Kāpuka	NZ Broadleaf	<i>Griselinia littoralis</i>												
Tūmatakuru	Matagouri	<i>Discaria toumatou</i>												
Harakeke	Flax	<i>Phormium tenax</i>												
Mānatu	Lowland ribbonwood	<i>Plagianthus regius</i>												
Tīkōuka	Cabbage tree	<i>Cordyline australis</i>												
Tauhinu	Narrow-leaf pomaderris	<i>Pomaderris phyllicifolia</i>												
	Teucrium	<i>Teucrium parvifolium</i>												
Pōhuehue	Creeping pōhuehue	<i>Muehlenbeckia axillaris</i>												
Putaputawētā	Marbleleaf	<i>Carpodetus serratus</i>												
Rōhutu	NZ Myrtle	<i>Lophomyrtus obcordata</i>												
Mākaka	New Zealand broom	<i>Carmichaelia australis</i>												
Wharariki	Mountain flax	<i>Phormium cookianum</i>												
Kānuka	Kanuka	<i>Kunzea ericoides</i>												
Mānuka	Manuka	<i>Leptospermum scoparium</i>												
Kōkōmuka	Banks Peninsula hebe	<i>Veronica strictissima</i>												
Houhi	Narrow-leaved lacebark	<i>Hoheria angustifolia</i>												
Tauhinu	Cottonwood	<i>Ozothamnus leptophyllus</i>												
Pōpōhue	Wire vine	<i>Muehlenbeckia complexa</i>												
Koromiko	Willow-leaf hebe	<i>Veronica salicifolia</i>												
	Canterbury Plains Tree Daisy	<i>Olearia adenocarpa</i>												
Tororaro	Shrubby Tororaro	<i>Muehlenbeckia astonii</i>												
Akeake	Mountain akeake	<i>Olearia avicenniifolia</i>												
Akiraho	Golden akeake	<i>Olearia paniculata</i>												
Whauwhaupaku	Five finger	<i>Pseudopanax arboreus</i>												

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A LIGHTER TOUCH

Fungicide programmes for managing stem rust in perennial ryegrass seed crops

Richard Chynoweth, MRB and Nicholas Davies, AgResearch

Key points

- Include mixed mode of action applications at ear emergence and flowering.
- GS 32 application is recommended for strategic early-season preparedness, especially when stem rust pressure is uncertain.
- Only apply the flowering +14-day application in seasons with late stem rust pressure.
- Strategic rotation of the mode-of-action of fungicides is important for product stewardship: Group 3 (Triazoles) and Group 7 (SDHI) chemistries are important across the arable rotation.

Impacts of stem rust

Perennial ryegrass (*Lolium perenne* L.) is the most common grass seed crop in New Zealand, particularly in Canterbury, which accounts for the majority of the nation's ~18,000 ha of ryegrass seed crops. Seed production underpins both forage and turf industries, with turf-type cultivars particularly dependent on high yields for economic viability due to limited returns from grazing.

Achieving optimal seed yield is often constrained by foliar pathogens, most notably stem rust (*Puccinia graminis* subsp. *graminicola*), recognized as the most destructive disease of ryegrass seed crops. Severe rust outbreaks can reduce yield by 10 to 200%, with unmanaged crops at risk of total failure. Stem rust disrupts green leaf and stem area, accelerates senescence, and compromises assimilate allocation during seed fill, directly affecting seed quantity and quality. Other foliar pathogens, including crown rust (*Puccinia coronata*), brown blotch (*Drechslera siccas*), and *Ramularia* leaf spot (*Ramularia pusilla*), may occur, but are generally of lesser economic importance.

Stem rust fungicide programmes

Management of these diseases in New Zealand relies almost exclusively on fungicides. Triazoles (DMI) have been the cornerstone of rust management for decades, with more recent integration of strobilurins (QoI) and succinate dehydrogenase inhibitors (SDHI) enhancing disease spectrum coverage and persistence of green leaf area. International and New Zealand trials indicate that early fungicide application, timed with key phenological stages such as stem elongation (GS 32) and ear emergence, combined with mixed modes of action, maximizes yield benefit, often exceeding 30 to 40% relative to untreated crops. Despite consistent evidence supporting timely fungicide programmes, questions remain regarding optimal timing, frequency, and economic justification for additional applications under variable disease pressure.

FAR stem rust trials

This study synthesizes results from ten completed field trials conducted in Canterbury between the 2017-18 and 2021-22 seasons and incorporates ongoing research evaluating two newer SDHI fungicides. The objectives were to quantify seed yield response to fungicide timing and programme structure, assess the marginal contribution of early versus late applications, benchmark common fungicide programmes against untreated controls, and provide practical recommendations for growers to optimize rust management strategies. Additionally, the ongoing trial seeks to evaluate the performance and integration of ELATUS® Plus and VIMOY®IBLON®, two recently registered SDHI fungicides, under local Canterbury conditions to assess their potential to improve yield and support sustainable resistance management.

Data were derived from ten completed field trials across five seasons, examining late-season fungicide efficacy and pre-GS 32 rust management. Trials were conducted on turf-type ryegrass cultivars, except Trials 1 and 4, which used forage cultivar Syringa. Fungicides were applied via a small-plot boom at ~240 L/ha across plots measuring 2.3 m × 10–12 m. Harvest occurred at ~40% seed moisture using a John Deere windrower, followed by plot combining 6–9 days later. Subsamples were machine dressed to meet first-generation seed certification standards.

Fungicide programmes included up to five growth stage applications: pre-PGR (post-closing), PGR (GS 32 stem elongation), ear emergence, flowering, and 14 days post-flowering. Yields were normalized as a percentage of the best-performing treatment within each trial to account for variation in disease pressure and environmental conditions.

The ongoing trial, initiated in the 2024-25 season, builds on these protocols to specifically investigate application timing, mixture compatibility, and yield response of ELATUS® Plus and VIMOY®IBLON®. Treatments include single and multiple applications at GS 32, ear emergence, and flowering stages, alone or in combination with conventional DMIs and QoI fungicides. The trial also monitors disease suppression, leaf area persistence, and potential interactions with growth regulators.

Results

Overall seed yield response

Treated plots consistently yielded higher than untreated ones. The best fungicide treatment plots averaged 2,499 kg/ha, versus 1,577 kg/ha from untreated plots (mean yield increase of 922 kg/ha (77%)). Yield responses varied from negligible (10 kg/ha, Trial 1) to substantial (1,600–1,750 kg/ha, Trials 5 and 9) under multi-application programmes including GS 32 and ear emergence sprays.

These results in Table 1 underscore the interaction between fungicide timing, disease incidence, and environmental conditions. While modest gains occurred in some trials, comprehensive programmes more than doubled yield under high disease pressure, highlighting the critical role of well-structured fungicide programmes.

Table 1. Seed yield response of the untreated control and best fungicide programmes from 10 field trials investigating different fungicide options on turf-type perennial ryegrass in Canterbury, New Zealand between 2017-18 and 2021-22.

Trial	Treatment#	Seed yield (kg/ha)			Percentage increase
		Untreated	Best treatment	Increase	
1	6	3020	3030	10	0
2	7	1049	1899	850	81
3	4	1629	2419	791	49
4	7	1838	2112	274	15
5	6	1028	2780	1752	170
6	2	1234	2774	1539	125
7	7	1401	2298	897	64
8	6	1293	1747	454	35
9	3	848	2488	1640	193
10	5	2425	3440	1015	42
Average		1577	2499	922	77

Fungicide application frequency

Yield as a percentage of the best treatment in Figure 1 show that the number of fungicide applications strongly influenced performance ($P < 0.0001$). Untreated plots achieved 56% of best treatment yields. One or two applications increased yield by approximately 32%, with three or four sprays contributing an additional 8%. Differences between one versus two applications, and three versus four applications, were not statistically significant, indicating diminishing returns beyond three well-timed sprays. Two-application programmes did not significantly outperform single-ear emergence applications, emphasizing timing over frequency.

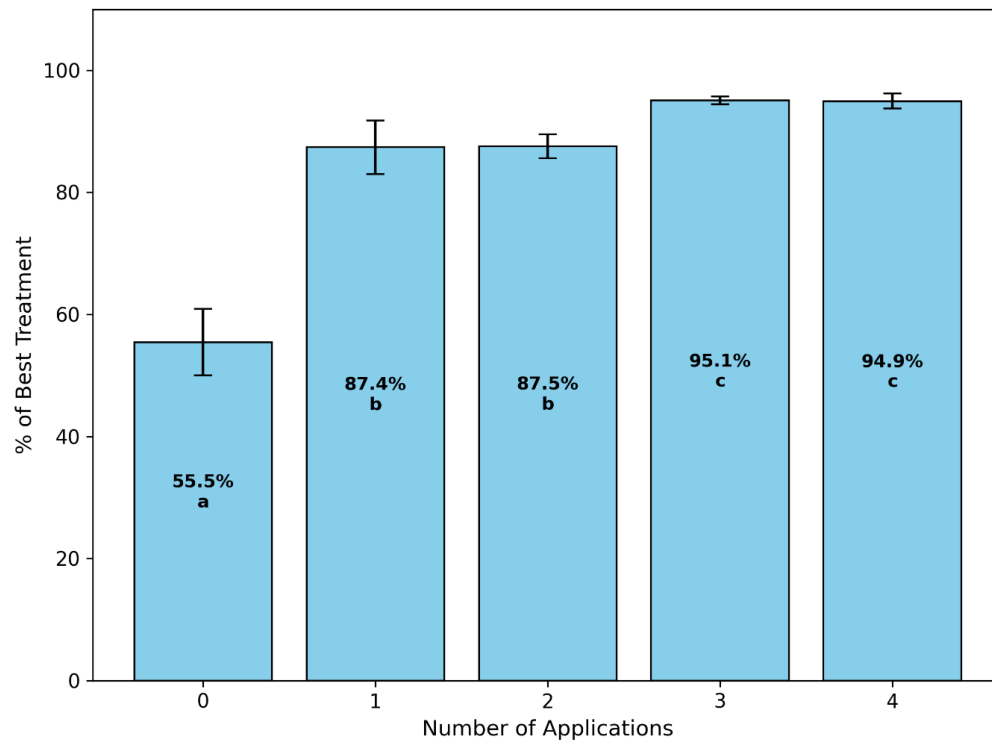


Figure 1. Relative seed yield of turf-type perennial ryegrass expressed as a percentage of the best treatment, grouped by number of fungicide applications per treatment. Data represent averages from 10 field trials conducted in Canterbury, New Zealand, between 2017 and 2021. Error bars represent the standard error of the mean, and letters indicate LSD groupings (**Error! Reference source not found.**).

Effect of GS 32 application

GS 32 coincides with stem elongation and emergence of the final leaves, a critical stage for canopy development and disease establishment. Five trials compared treatments with and without fungicide at GS 32, Figure 2. While individual trials showed minimal differences, aggregated analysis revealed a consistent yield benefit of 253 kg/ha when GS 32 fungicide was included ($P = 0.028$), increasing mean yield from 2,191 kg/ha to 2,444 kg/ha. This supports inclusion of GS 32 sprays as a preventative measure against early-season stem rust.

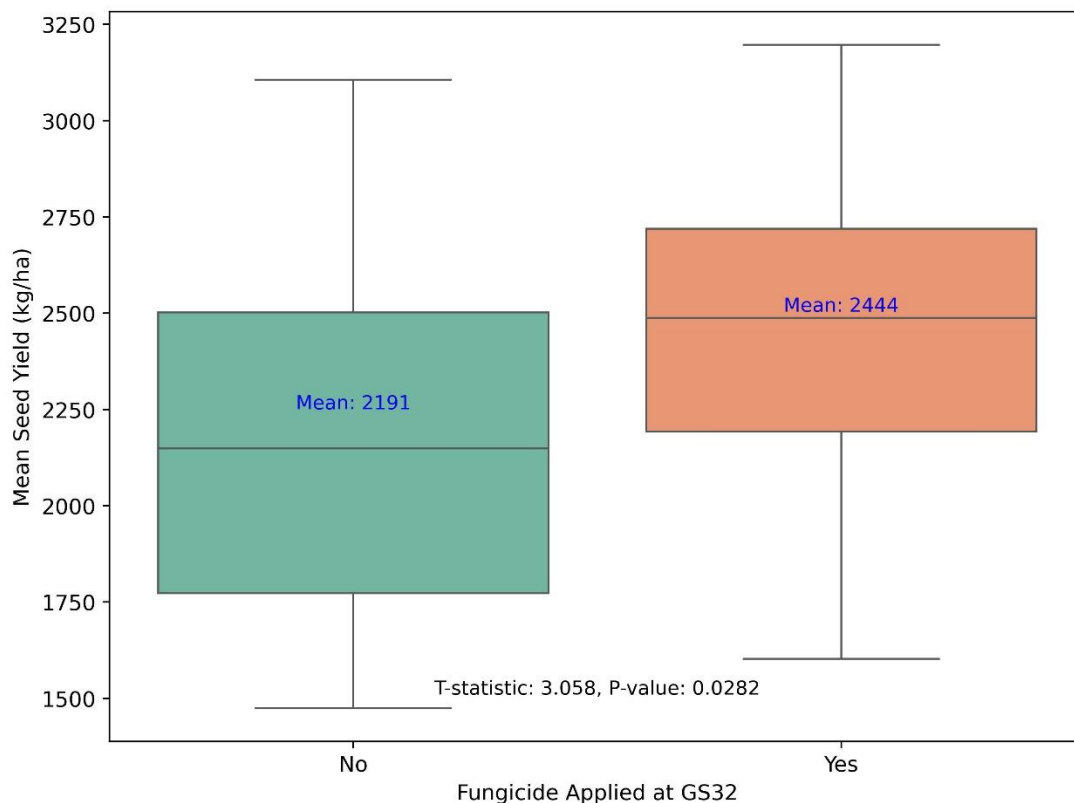


Figure 2. Seed yield of perennial ryegrass when fungicide was either included or excluded from the plant growth regulator applied at GS 32, data from five individual experiments where treatments were followed by identical fungicide programmes.

Effect of flowering +14-day application

Limited comparisons (four trials) indicated that fungicide applied 14 days post-flowering provided no significant yield benefit, Figure 3 ($P = 0.078$). Late-season sprays should be conditional on persistent disease pressure rather than routine. Treatments in the current SDHI trial include flowering +14-day applications to determine whether these newer chemistries extend canopy protection beyond conventional programmes. It should be noted that withholding periods differ among products, if grazing is intended after harvest, some products may not be suitable.

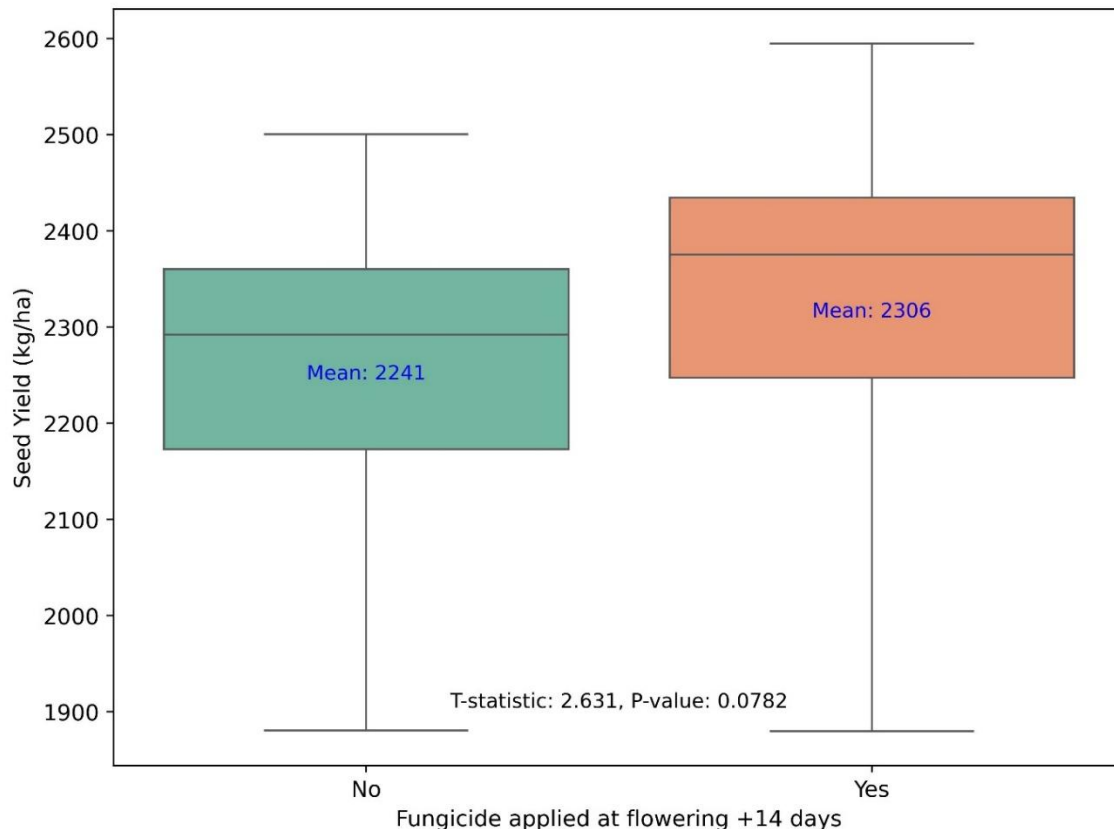


Figure 3. Seed yield of perennial ryegrass when a flowering + 14 day fungicide was either included or excluded after a standard three spray program including applications at GS32, ear emergence and flowering. Data from four individual trials.

Product comparison

Eight fungicide products were evaluated in completed trials. ELATUS® Plus (typically mixed with Proline®) achieved the highest average performance (98%), followed by Comet® (96%) and Proline® (94%). Seguris® Flexi, despite frequent use, had slightly lower mean performance (92%), likely due to association with smaller programmes. Untreated controls averaged 63%. SEM values were low (<1.5%) for widely replicated products, indicating consistency across seasons.

The ongoing trial will provide a further dataset including the better performers identified over the previous trials including ELATUS® Plus, Proline®, Comet®, Seguris® Flexi and VIMOY®IBLON®. See Table 2 for the trial treatments and timings. Note that some of the treatments are specifically designed to enable the extraction of data regarding relative performance and are against label requirements. These treatments should not be used in practice.

Discussion

Completed trials confirm that fungicide programmes substantially enhance turf-type perennial ryegrass seed yield in Canterbury. Mean yield gain of 922 kg/ha (77%) aligns with previous New Zealand studies, though variability reflects environment, disease pressure, and cultivar susceptibility. Timing is critical: ear emergence sprays delivered the largest adjusted yield gains (up to 1,085 kg/ha) with mixed-mode-of-action programmes. GS 32 contributed a consistent but smaller benefit (+253 kg/ha), supporting its use as an early-season risk management strategy. Flowering +14-day sprays provided no significant yield improvement, reinforcing selective late-season application.

Three well-timed applications (GS 32, ear emergence, flowering) optimized yield relative to inputs. Additional sprays provided minimal extra benefit, emphasizing alignment with crop phenology and disease risk.

The ongoing SDHI trial is evaluating the efficacy of VIMOY®IBLON® and ELATUS® Plus by incorporating these newer SDHIs to more traditional programmes, the trial will provide data to optimize mode-of-action diversity, disease control, and yield outcomes, supporting both agronomic and resistance management objectives. The treatment list can be found in Table 2.

The results from these ten trials confirm that considered fungicide use can significantly enhance seed yield in turf-type perennial ryegrass grown under Canterbury conditions. These findings emphasize that yield gains are greatest when fungicide programmes are timely and comprehensive, particularly during seasons of high disease pressure.

Table 2. Stem rust treatment list for in Collosum turf at Chertsey for the 2025-26 season. The trial investigates the use of VIMOY®IBLON® and ELATUS® Plus compared with older treatments of Proline®, Comet® and SEGURIS® Flexi.

Treatment	GS 32 Node 2 at least 2 cm above node 1	GS 55 Middle of heading	GS 65 Full flowering: 50% of anthers mature
1	Negative Control	Negative Control	Negative Control
2	Proline® (0.4)	Proline® (0.4) SEGURIS® Flexi (0.6)	Proline® (0.4) SEGURIS® Flexi (0.6)
3	Proline® (0.4) Comet® (0.8)	Proline® (0.4) SEGURIS® Flexi (0.6)	Proline® (0.4) SEGURIS® Flexi (0.6)
4		Proline® (0.4) SEGURIS® Flexi (0.6)	Proline® (0.4) SEGURIS® Flexi (0.6)
5		Proline® (0.4) VIMOY® IBLON® (1.5)	Proline® (0.4) VIMOY® IBLON® (1.5)
6		Proline® (0.4) ELATUS™ Plus (0.75)	Proline® (0.4) ELATUS™ Plus (0.75)
7	Proline® (0.4)	Proline® (0.4) VIMOY® IBLON® (1.5)	Proline® (0.4) VIMOY® IBLON® (1.5)
8	Proline® (0.4)	ELATUS™ Plus (0.75)	ELATUS™ Plus (0.75)
9	Proline® (0.4) Comet® (0.8)	Proline® (0.4) VIMOY® IBLON® (1.5)	Proline® (0.4) VIMOY® IBLON® (1.5)
10	Proline® (0.4) Comet® (0.8)	Proline® (0.4) ELATUS™ Plus (0.75)	Proline® (0.4) ELATUS™ Plus (0.75)

Note: Trialing numbers are in L/Ha. Some of these treatments are specifically designed for the extraction of comparative data and are against the label requirements. These treatments should not be used in practice. Comet® a.i. 250 g/L pyraclostrobin, Elatus® Plus a.i. 100 g/L Benzovindiflupyr (Solatenol®), Proline® a.i. 250 g/L prothioconazole, Seguris® Flexi a.i. 125 g/L isopyrazam, Vimoy® iblon® a.i. 50 g/L of isoflucypram.

Acknowledgement: This work is supported by the Seed Industry Research Centre

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Understanding limitations on seed yield in red clover seed crops

Sean Weith, FAR; Richard Chynoweth, formerly FAR, now MRB and Phil Rolston, SIRC

Key points

- Sixteen commercial red clover crops distributed across South, Mid and North Canterbury were surveyed during the 2023–24 season.
- The survey revealed a huge gap between achievable and achieved red clover seed yields, with most crops performing well below their potential.
- Harvest losses are likely underestimated and represent a significant barrier to maximum productivity.
- These findings highlight the need for integrated management of canopy structure, pollination and harvest practices.

Background

Red clover (*Trifolium pratense* L.) is a widely cultivated forage legume valued for both grazing and seed production. In New Zealand, red clover seed yields often fall short of their biological potential, typically producing 200–500 kg ha⁻¹, a range lower and more variable than those seen internationally. To investigate factors influencing realised seed yield, 16 commercial red clover crops across South, Mid and North Canterbury were surveyed during the 2023–24 season. At each site, pre-desiccation sampling measured aboveground biomass, stem density, flowerhead density, florets per inflorescence, and the proportion of florets containing seeds. These traits were used to estimate seed set potential seed yield (florets producing harvestable seed), while realised seed yields obtained from growers allowed estimation of harvest losses.

Results

Figure 1 below provides a summary of results from this survey. Across all surveyed sites, the mean realised seed yield was 473 kg ha⁻¹ (range: 200–850 kg ha⁻¹) while seed set potential yield was 790 kg ha⁻¹ (range: 166–2012 kg ha⁻¹). While yields were higher than anticipated, most crops underperformed relative to their seed set potential, reinforcing the substantial gap between yield achievable after pollination and early seed development and actual achieved yield. Correlation analysis indicated only weak to moderate associations between yield components (data not presented). These results suggest that factors beyond these key yield components are constraining yield, with canopy management, pollination efficiency or insect feeding likely acting as key bottlenecks.

On average, 60% of florets contained seed (Figure 1), suggesting that pollination is not the primary source of yield loss. Other unrecorded factors, such as paddock size and distance from pollinator nesting sites, may also affect pollination efficiency and merit further investigation. While pollination did not appear to be the main driver of yield loss in this study, improvements could still provide modest gains, but are unlikely to close the gap between potential and realised yield on their own.

The gap between potential and realised seed yield suggests that late insect damage or harvest losses in New Zealand red clover are underestimated and may represent a major barrier to achieving maximum yields. Losses at or before harvest can substantially reduce returns, even when pollination and crop management are effective. Addressing this will require greater focus on optimising harvest timing, combine setup, and handling, alongside improvements in canopy and pollination management.

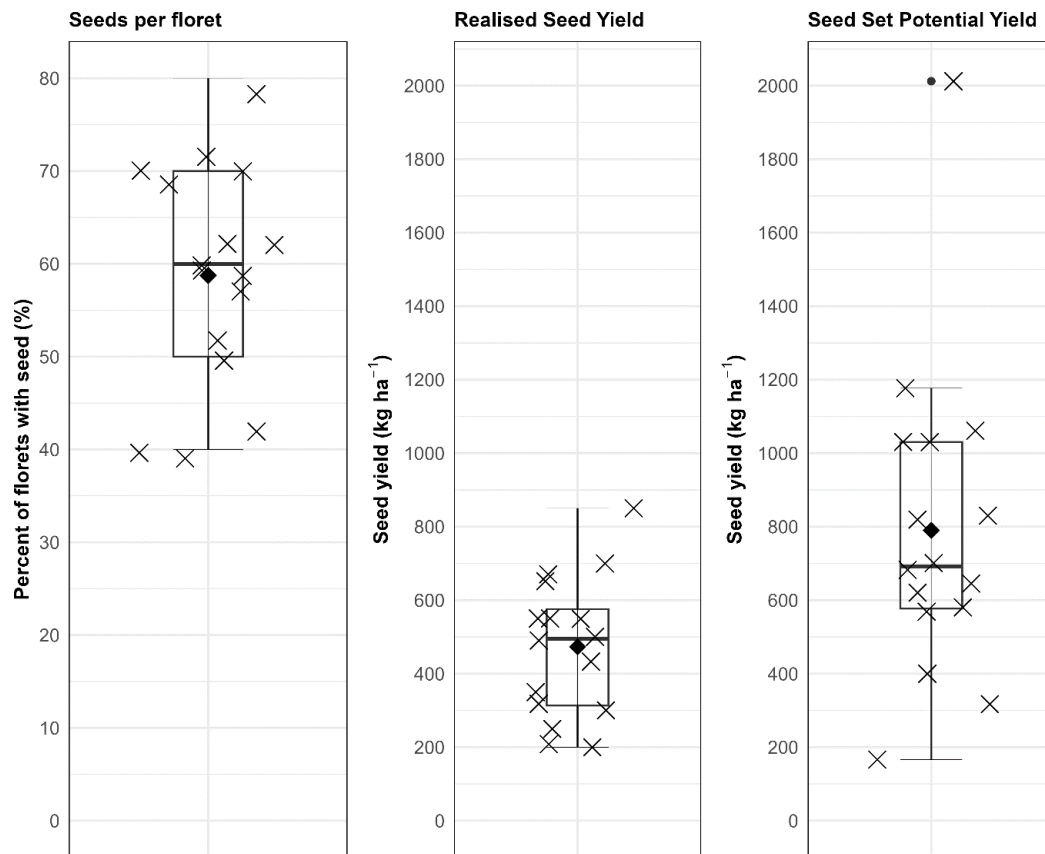


Figure 1. Variability in the percentage of florets containing seed and realised (actual) and potential seed yield (kg ha⁻¹) based on florets with developing seeds from 16 red clover (*Trifolium pratense* L.) crops surveyed across Canterbury, New Zealand during the 2023–24 growing season. In each box, the line represents the median, diamonds show the mean and circles indicate outliers.

Acknowledgement: This work is supported by the Seed Industry Research Centre.

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Notes:

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