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ADDING VALUE TO THE BUSINESS OF CROPPING

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From the Ground Up

ADDING VALUE TO THE BUSINESS OF CROPPING

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Word of the year...

Every year various publications announce their chosen word of the year (WoTY). WoTY is defined as the 'the most important word or expression in the public sphere during a specific year. So far, I've seen two announcements for 2023; 'authentic' and 'rizz' (charisma or romantic appeal). And while both of these, clearly, can be applied to the arable industry, I'm proposing another option…how about 'efficient' or 'efficiency'?

It seems that just about every FAR field day, event or publication has at least one person focusing on such approaches; think nutrient use efficiency (NUE), water use efficiency (WUE), fuel efficiency and overall input efficiency.

The Oxford dictionary defines efficient as 'achieving maximum productivity with minimum wasted effort or expense' or 'working in a well-organised and competent way'.

Presentations at our recent ARIA event and combine workshops focused directly on 'achieving maximum productivity with minimum wasted effort or expense'. For example, FAR's Abie Horrocks and grower, Peter Mitchell, discussed extending the value of ryegrass seed crops by adding legumes into post-harvest re-growth to increase winter feed quality and reduce N fertiliser spend for following crop; Jo Drummond's presentation on fungicide stewardship noted that selecting a resistant cultivar and choosing an appropriate fungicide programme are the keys to efficient cereal disease management; and Peter Broley of Primary Sales Australia suggested that by altering combine set up growers could halve harvest losses... increasing harvest yield and income.

With the cost of everything increasing by the minute, any low-cost action that will save money, or increase production will add to your bottom line. Have you had a close look at your system? Are there any areas that could be tweaked to increase efficiency? Alternatively, are there any areas where a bit more investment would increase returns? It's worth thinking about.

These ideas will also come to the forefront at our FAR Maize Conference in February. The conference, entitled Maize Profit & Productivity will include three indoor sessions and a field trip to FAR's Northern Crop Research Site to check out 2023/24 maize trials. As well as two international speakers, there will be three farmer panels, where maize growers will share their thoughts on how to run efficient and profitable maize production systems. Registrations are now open at www.far.co.nz - if you're a maize grower, I look forward to seeing you there.

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Scotland, storms and subsidies

It seems that extreme weather events can hit arable farmers no matter where in the world they are. A day into my trip back home, Storm Babet hit, and large swathes of Scotland's east coast found itself under water. So much for my planned grower visits to catch up on winter planting; but fear not, thanks to my intrepid tour guide, Gordon Rennie, there was still plenty to see and do, resulting in lots of interesting insights into what is happening in the Scottish arable industry.

Scottish arable farming has a lot in common with New Zealand arable. The farm systems are highly diverse, incorporating arable and vegetable crops and livestock in the rotation. Many of the agronomic challenges, such as pesticide resistance, nutrient use efficiency, resilience to environmental stresses etc are the same, and not surprisingly this has led to similar productivity and profitability constraints. The big difference is that Scottish growers get quite a bit of financial support from the government. Pre-Brexit this was in the form of a range of subsidies for producing food and feed, but these have now gone, and instead growers can receive payment for implementing a plethora of environmental initiatives on their farms. These range from improved stubble management, establishing winter cover crops and implementing IPM systems, all the way through to establishing hedgerows and providing winter bird food. The list of potential payments is long and the process to apply quite complex, so most growers contract a consultant to help them manage the process.

I was a little skeptical about this to begin with, since the process seems open to manipulation and exploitation, (and I am sure that some of that does happen), but I also think that a lot of growers genuinely want to improve their 'farm environment' and that these payments allow them to do this without compromising the farm's financial viability. In contrast, New Zealand's approach of wielding a stick and imposing charges/levies on growers if they don't implement certain changes seems quite draconian and unlikely to yield any better results. Having spent two years in the HWEN tent, seeing the substantial cost of implementing a pricing levy on farm emissions, I am inclined to think that we would be better off using the money to incentivise growers to make the necessary changes. It just seems like a much more positive and cooperative model to drive environmental outcomes (although I can see that some of the NGOs and urban dwellers would see this as another example of the government letting the farming sector 'off the hook').

Maintaining a sustainable energy supply is a big focus in the UK and the farming sector is contributing to the various solutions. Growers are leasing their land for wind turbines or, in many cases, investing in their own infrastructure and selling power back to the grid. They are installing solar panels on their less productive land, or in some cases in combination with their crops/stock. An increasing number are also investing in anaerobic digestors; producing gas to feed into the national gas network. The banks seem favorably inclined to provide loans for these initiatives and the growers that I spoke to say the revenue generated is certainly improving their bottom line. New Zealand growers have explored some of these options and while in many cases the business case hasn't necessarily stacked up, it is always worth taking a second look in light of increasing energy costs.

Just like the New Zealand arable industry, Scotland's industry is always on the look out for new crop opportunities, and just like us, they have recognised how challenging it is to find a suitable crop that can fit into the arable rotation and provide added value above the standard commodity prices. Not surprisingly they are looking at plant protein crops such as chickpeas and faba beans, but they are also looking at coloured grains, naked barley and oats, sugar beet and flax. These will most likely be niche crops, grown regionally to service local markets, since arable crop production in Scotland, just like in New Zealand, is high cost per unit area of land compared with many other countries.

Probably the thing that most surprised me from my visit was the number of farm shops that had sprung up over the five years since my last trip. It seemed that every main thoroughfare leading to a city or tourist spot had farm shops along the way. I visited four on my trip and was amazed at the quality and diversity of produce on sale. All were owned and operated by the farm business and ranged from a small 1-2 person entity selling one farm's produce up to a large business selling a wide range of local produce supplied by neighbouring farms with a café/restaurant and flower shop employing 60 people. All started off as small market stalls by the side of the road with minimal funding and then grew slowly (some quite quickly) to being successful businesses contributing a substantial component of the farm business revenue.

I am not suggesting that any of these specific examples will work in New Zealand, they may or they may not, but what did inspire me from my visit was that so many of the growers are trying new things to build more resilience into their business.

My last comment is a big thank you to Gordon for organising my itinerary and taking me round the countryside. I think I chatted to more than 20 different groups of people over the four days which felt akin to speed dating. And I visited a few castles along the way. And it rained the whole time.

Alison Stewart

Support for international event attendance

Did you know that FAR has a fund to support growers who wish to attend relevant international conferences and events? FAR levy payers can apply for a grant to attend international industry-related conferences, workshops, events, etc

Applications are assessed on a case-by-case basis, and if approved, the amount offered ranges from NZ$500 up to a maximum of NZ$1,500 per application.

Contact far@far.org.nz for more information.

A word from the Chair

2023 has been an 'eventful' year, starting with Cyclone Gabrielle which hit the North Island, and the East Coast in particular. The resilience of the people affected has been tested, but thanks to community support and a lot of hard work some sort of normality is starting to return. However, reoccurring rain events continue to affect these growers' ability to grow and sell quality crops. I hope 2024 will bring them some respite.

I would like to thank everybody for the support FAR received in the referendum. The result was positive and all the paperwork is now awaiting the attention of our new Minister of Agriculture. Assuming all goes well, the new Levy Order will be in place by the middle of next year. FAR staff, board members and ARG members had many conversations with levy payers during and after the referendum. We received both positive and critical feedback. FAR is now 27 years old, and as with all organisations, our practices and procedures have evolved based on the knowledge of the day. This evolution will continue as we review our constitution, structure, research priorities and communication to ensure that they remain up to date and fit for purpose.

At the end of November, we held our ARIA event at the Chertsey Arable Site. Presentation topics included weed management in ryegrass and clover crops, multi-year seed crops, crop competition in weed control, extending the value of ryegrass, and fungicide use in cereal crops. I have to admit that I didn't hear all the presentations because catching up with people you don't meet regularly is also an important part of that day!

It was great to hear English farmer Rob Waterston's approach to increasing resilience on his property. Some of his approaches could be tested here, but others would not work, as they rely on subsidies for financial viability.

As 2023 comes to a close, I hope everybody will have time to enjoy the festive season and emerge fully refreshed to start the harvest. Recent workshops have been a good reminder of the importance of setting up our combines the best way possible, so as not to waste what we worked so hard for during the year.

The 2024 Maize Conference will be held on the 12-13 of February in Hamilton and I am looking forward to meeting a lot of maize growers at the event. We have started growing maize on our farm in Mid-Canterbury, and I know we have a lot to learn.

Steven Bierema

Seed + Grain Readiness & Response

Notification of Biosecurity (Response—Arable Crops Levy) Order 2023 levy rates

Seed and Grain Readiness and Response Incorporated (SGRR) is a biosecurity entity for the arable sector established in 2020. SGRR partners are Federated Farmers Arable Industry Group, United Wheat Growers of New Zealand, Foundation for Arable Research, New Zealand Flour Millers Association and New Zealand Grain and Seed Trade Association.

The SGRR Board has set the Biosecurity Levy rates for the 2024 calendar year. The collection of the levy will formally commence on 1 April 2024 for the first point of transaction and the costs shall be shared between industry and growers as outlined below:

- Arable Crops Biosecurity Levy set at a rate of 0.1% on harvested seed or grain (except maize)
  - Split 50/50 between growers (0.05%) and merchants or processors (0.05%)
- Arable Crops Biosecurity Levy will run to build a reserve of a minimum of $1M
- Maize Biosecurity Levy set at a rate of 0.5% on hybrid seed sales
  - Split 50/50 between growers (0.25%) and merchants (0.25%)
- Maize Biosecurity Levy will run to build a reserve of a minimum of $500K

Background

During 2018 and 2019, a total of 12 Government Industry Agreement (GIA) Biosecurity consultation meetings were held across the country, allowing stakeholders to raise any questions and vote on the key topics presented. Of those that attended these meetings, 92.4% voted in favour of initiating a Biosecurity Levy Order to fund biosecurity responses.

In 2023, SGRR applied for the introduction of a Biosecurity Levy to fund readiness and response activities. This levy was approved by the Government in July 2023 and initially set at zero, with a maximum (cap) of 1% on the first transaction of products identified for recovery. The levy will be payable at the first point of sale as per clause 4 of the Biosecurity Order 2023.

Since its establishment, SGRR has been involved in three responses; Pepino Mosaic Virus - April 2021, Black grass - December 2021 and Fall armyworm - March 2022. Under the GIA, SGRR is obligated to share the costs of the responses with MPI and other affected sector organisations and to build minimum reserves to face future incursions. Our known share in the responses carried out so far is $562,061 + GST with further costs associated with the ongoing black grass response still to be determined.

What is the Biosecurity Levy Order?

The Biosecurity (Response—Arable Crops Levy) Order 2023 imposes a levy on certain transactions involving arable crops. It came into force on 1 July 2023 and is administered by the Ministry for Primary Industries.

The concept of the “arable levy order” is a regulatory mechanism that imposes a mandatory financial charge, known as a levy, on certain transactions within the arable crops industry. It is a means of raising funds from stakeholders, such as growers, processors, and distributors, for specific biosecurity purposes related to the industry, particularly biosecurity response.

For SGRR, the levy ensures commitments are met to response activities under the GIA for the Biosecurity Readiness and Response deed signed by SGRR on 23 March 2020 and any operational agreements of a similar nature made between the Director-General and SGRR.

The Biosecurity (Response—Arable Crops Levy) Order 2023 levy can be viewed on the Government New Zealand Legislation website

Biosecurity (Response—Arable Crops Levy) Order 2023 (SL 2023/78)Contents – New Zealand Legislation

Please do not hesitate to contact me if you have any queries.

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Managing barley nitrogen and PGRs

FAR cereals researcher Jacqueline (Jax) Straathof is trialling different nitrogen rates in barley.

Barley management is being reviewed to gauge whether current recommendations, particularly around nitrogen rates and timings, are still fit for purpose.

The FAR Canterbury trials are canvasing a range of different nitrogen (N) and plant growth regulator (PGR) treatments for autumn and spring sown barley crops based on predicted yield.

FAR cereals researcher Jacqueline (Jax) Straathof says FAR received several grower requests to review its barley management guidance. Since these were last updated, in 2014, plant genetics and chemistry has changed. Some growers are also encountering problems with lodging and high screenings in barley.

Current guidance indicates that barley generally utilises 20 to 25 kg/N for each tonne of grain produced.

This year FAR initiated a new project “Optimising agronomic management of autumn and spring sown barley” to re-evaluate agronomic management of barley and establish a new regional guidance.

Nitrogen and PGR management will be examined to identify the sweet spot between N rate and PGR management to reduce lodging and brackling without compromising grain quality, says Jax, who is carrying out the trial work with another FAR researcher, Emmanuel Chakwizira.

In year one (2023-24), FAR established five trials in Canterbury:

- Two autumn sown trials at the Chertsey Arable Site (irrigated and non-irrigated). These are trialling low, medium and high N rates. Plots all have the same PGR on-label treatment to better identify plant response to N rates.
- One spring barley trial on a farm near Lincoln.
- One autumn and one spring barley demonstration trial at the Kowhai Arable Site at Lincoln with multiple combinations of N rates and PGRs. The Kowhai trials are non-replicated and are designed to screen N and PGR rates that are worth further exploration.

Two barley varieties are being trialled, Transformer and Laureate. Data will be collected on tillering, biomass, stem length and thickness, lodging and brackling and grain quality. NDVI (used to quantify vegetation greenness) measurements and soil and leaf N samples will be taken regularly.

“The results should give more up-to-date information about the effect of nitrogen on the growth of the plants and the effect on grain quality and lodging/brackling,” Jax says.

“This information should help develop further trials in order to find the optimal treatment rates for Canterbury, with plans to expand it to other arable regions in future.

While wheat and barley tend to be treated the same, as they are both cereals, they are different crops with different end uses, Jax says.

Seed set is established much earlier in barley than wheat (at the start of stem elongation), and barley has a weaker stem.

In barley, early N (before stem extension) increases the number of tillers, with more tillers leading to more potential ears.

Nitrogen applied during stem extension extends the canopy and increases leaf size, which is needed for maximum radiation interception to support the increased number of tillers. However, a larger canopy with more tillers requires more water to support itself.

High levels of N can result in lower yields with N being diverted to support vigorous vegetative growth, resulting in more screenings.

Nitrogen applied after stem extension can prolong the survival of yield-forming leaves. However, spring barley can tiller throughout the season and late N can encourage development of secondary tillers.

Late nitrogen also increases the protein level in grain, which can cause issues for malting barley.

Nitrogen application causes stem/internode elongation which makes the plant vulnerable to lodging and brackling, so PGR management can be vital.

FAR’s cereals team has been boosted by the appointment of Jax who started in January.

Jax has spent most of her working life involved with Plant Breeders’ Rights trials, initially in the Netherlands and then in New Zealand after emigrating in 2018.

Last year she decided it was time for a change and to do something new. She could see that the FAR role would be challenging for years to come in terms of knowledge building and being able to make a difference. She also enjoys being part of a team effort at FAR.

FAR senior cereals researcher Jo Drummond says “Jax’s appointment has allowed us to have the resources for a more comprehensive barley programme, which we are looking forward to expanding in the coming seasons.

“Jax brings energy and experience to the team and has already made an impact.”

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Combine workshops to reduce harvest losses

Arable growers may be losing thousands of dollars in profit through harvest losses because of a less than optimum set up of their combine harvester, says a visiting Australian expert.

Primary Sales Australia chief executive Peter Broley says it is important for growers to accurately and regularly measure grain and seed losses from their combine harvesters so adjustments can be made.

“Machinery and front losses are things we can change, in contrast to losses from a weather event like rain or wind.

“If we measure, we can halve our losses, which is what happened in Australia.”

To avoid potential yield and profit losses, FAR held a series of South Island grower field events which examined combine harvesters from the front to the back to ensure as much yield as possible goes into the silo this coming harvest. The events were very well attended, with over 200 people participating.

Peter Broley was part of a team of experts from Australia, brought in by FAR for the workshops. They have run dozens of similar events across the Tasman.

The over-subscribed workshops, in Mid and South Canterbury and Southland, were hands-on, with some growers bringing their own combines and fronts as a basis for discussion on different set ups.

A Grains Research and Development Corporation (GRDC) study of arable farms in Western Australia showed that $320 million of grain and seed was likely left in paddocks in 2021 from front and other machine losses. This is equivalent to a loss of $80,000 a grower.

At the Mid Canterbury workshop, growers pointed out that they are already measuring crop losses, mainly using improvised methods such as running behind the back of a harvester with a shovel, or using a tray, bag or cardboard mat. Asked how often they measured, one grower said it depended on how expensive the crop was.

The GRDC study showed that growers using commercially available drop trays averaged 1.3 per cent machine losses across all crops, compared with 2.9 per cent for those not using trays.

Factors in front losses are front type and set up and in back losses travel speed, rotor clearances, fan speed and sieve settings.

Not only can growers reduce their harvester losses, but improved operator confidence in their combine set-up means they can increase their harvesting speed and productivity, Peter Broley says. With combine running costs of $600 to $700 an hour, this can bring savings in fuel, labour and depreciation as well as more timely harvesting of crops.

A Mid Canterbury grower who imported a drop tray system two years ago said that farmers could pay for it in the first paddock, particularly with small seeds. “You can make big gains quite quickly in the first year.” After using the drop tray to fine-tune his combine he was able to increase his speed in wheat crops from 3.5 to 4 km/hour.

Australian harvester specialist Brett Asphar told the workshops that once a grower has measured their losses they need to find out where they are occurring.

He advised growers to only adjust one thing at a time, run their combine for a few minutes, then do a drop tray sample to gauge whether the change has made a positive difference. FAR’s technology manager Chris Smith says the workshops were a good fit for FAR’s technology extension programme which aims to help growers gain efficiencies from machinery and technology.

“Growers have only one opportunity to harvest a crop. Once it is gone out the back of the harvester it is too late.”

In January, during harvest, members of the team will return to gauge how well the adjustments made are performing in the field.

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Assisting growers on road to recovery

Flooding and silt deposits during February's Cyclone Gabrielle caused significant damage to Hawkes Bay and Tairawhiti/ Gisborne cropping land.

To assist growers with their recovery and provide a resource for similar future events FAR is leading a project focusing on grower decision-making in the worst affected regions.

FAR senior environment researcher and project co-ordinator Dirk Wallace says grower groups have been established in Wairoa, central Hawkes Bay, Heretaunga, Gisborne/Tairawhiti and Tolaga Bay. These will be supported by local facilitators, Alan Kale of ELAK Consulting and Diana Mathers of DJ Communications in Hawkes Bay, and Elliot Calendar and Melanie Briant of EC Consulting in Tairawhiti.

The project is working with 18 growers across 41 individual sites.

Farming on these damaged arable soils is diverse, with perennial horticulture, fresh and process vegetable production and mixed arable systems with cropping, sheep and beef and contracting activities. Arable crops include maize, barley and wheat as well as seed crops, while vegetables include process peas and sweetcorn, salad vegetables, tomatoes, beetroot and pumpkins.

Challenges are managing deposited sediment and debris which involves leveling uneven paddocks, sediment up to 1 metre deep, paddock access, restoring soil fertility and dealing with log debris scattered through paddocks. Most with shallower sediment have worked it in with the original soil.

As well as providing support, the project aims to build case studies that document the grower decisions made, what worked and what didn't.

"It is important to learn from the past and having a bank of resources built on farmer experience and science will support confident recovery and resilience in the future," Dirk says.

Funding for the six-month project is from the Ministry for Primary Industries (MPI) via its North Island weather event fund.

"What we are doing, particularly in Hawkes Bay, is following the results of that management. What it cost growers and how it has affected establishment of spring crops."

FAR is running the project in conjunction with Horticulture NZ's Vegetable Research and Innovation Board.

First, the project will document how each site was impacted, for example the degree of sediment deposited from flooding. It will then detail each growers' decision making, for example did they plant a winter cover crop, leave it, or work the sediment into the soil.

"What we are doing, particularly in Hawkes Bay, is following the results of that management. What it cost growers and how it has affected establishment of spring crops.

"If I was to put it simply, the role of this project is to document hindsight.

"From talking to growers, a lot have been through events like this in the past and they recognise that it would be good to document what they did and what worked, so growers in the future can utilise this and respond more easily."

As economic impacts are significant, most growers have planted some type of crop this season, if possible, to maintain cashflow. More planting of maize is expected on flood-affected land as it is viewed as a hardy, deep-rooted crop option.

"It seems that this season, growers are going with lower cost, lower risk options on more flood affected land with a view to getting back into higher-value vegetable options in the future."

Soil sampling is available, with flexibility regarding timing, depending on each grower's situation. Agronomic support is being provided by facilitators, while FAR's technology manager, Chris Smith, is leading the use of satellite imagery maps to assess crop variability through the season.

Discussion on cyclone recovery for the cropping sector has been included in events run by FAR and HortNZ in the affected regions.

"The majority of growers have just got going. It is more of a case of us learning with them," Dirk says.

Below: FAR senior environment researcher Dirk Wallace, right, and Tolaga Bay maize grower Toby Parker assess a maize crop ruined by Cyclone Gabrielle.

After the cyclone

When confronted with a problem such as the damage caused by Cyclone Gabrielle, farmers want to get stuck in and try and fix it as soon as possible.

However, sometimes it is better to wait until paddocks have dried out before starting remedial activity, says a Hawkes Bay farm facilitator and former FAR researcher Diana Mathers. Diana is one of four facilitators in the Hawkes Bay and Gisborne/Tairawhiti regions involved in a FAR project documenting farmer decision making in the wake of the cyclone.

Silt deposits in flood affected districts ranged from 1 metre deep in Wairoa down to a few centimetres.

“So, there was huge damage and a massive economic loss, with many crops ruined just as they were due to be harvested.”

Central Hawkes Bay and the Heretaunga Plains farmers started working the ground as soon as they could using mulchers, spaders and rippers. Most worked the silt in, though in some cases it was scraped off and removed.

In Wairoa, where the silt is too deep to be incorporated into the soil, growers will plant on top of it when they can, but with ongoing downpours throughout November, it is still too wet.

In central Hawkes Bay, spring crops have been planted and are looking all right; farmers are optimistic. “But it’s been a lot of extra work to get the land back into a state where it can be planted. Some growers have done six and up to 12 passes to work the ground.

“Growers are very generous with their information. They are keen to capture the experience so if it happens again there are records and resources, so we’ll know what worked and what didn’t work,” Diana says.

One farmer told her: “We’ve told the staff to look forward - we’re not looking back.”

Key lessons include waiting a bit longer for the land to dry out before starting remedial work.

“As much as farmers want to get going quickly, it’s prudent to wait until the silt has dried enough. Working soil up too soon can create extra work. If they leave it a little longer than perhaps they want, the job is easier and fewer machinery passes are required to get it into a workable condition. So, be patient and wait.”

Mistakes have also been made. In one wet area grass seed was flown on, and later, the grass that had grown was sprayed off to plant maize. However, as the ground is still too wet for machinery it would have been better to retain the grass cover. “It was a decision made too quickly.”

“Key lessons include waiting a bit longer for the land to dry out before starting remedial work.”

Another paddock, with 30 cm of sediment, was left alone. It cracked into blocks as it dried and plants from a previous grass crop are growing through. “So, it does recover, but it is a slow process.”

While silt is high pH and doesn’t have a lot of nutrients, soil tests show that where it has been worked in, fertility is similar to before the cyclone.

Cyclone Gabrielle damage.

Automated crop disease monitoring

A high-tech automated system that takes the guesswork out of predicting fungal crop disease outbreaks is being evaluated by FAR. BioScout measures spore numbers daily and sends them to growers via custom dashboard software, in conjunction with standard weather data (temperature, humidity, rainfall, wind speed and direction).

The BioScout disease detector is being validated at FAR’s Chertsey Arable Research Site as well as on a Methven mixed arable farm which hosts Cereal Performance Trials.

Australian-based automated disease detection technology company BioScout has developed the technology which is already used in Australia’s viticulture and arable sectors.

FAR technology manager Chris Smith says FAR is always looking for new technology to test to help growers and that FAR is helping to collect data to feed BioScout’s AI systems for diseases of interest to our arable industry and validating the technology’s value for spore detection.

How does the technology work?

BioScout uses spore-collecting sensors and AI to detect airborne disease particles before they’re even visible in crops. The technology essentially brings the lab into the paddock and makes disease detection less laborious and more accessible for growers.

A small fan pulls the air into the narrow inlet and microscopic particles in the airstream such as fungal spores and pollen adhere to a transparent tape. After a controlled sampling time, the robotic imaging system moves the tape like an old VCR to place the sample in front of an automated microscope which takes up to 240 images.

From here, images are sent back to a server, using a 4G network, where an AI system scans them for diseases. Once uploaded to the BioScout dashboard software, growers can filter data based on individual units, target diseases and timeframes to help make informed decisions on disease management.

The units are self-sufficient, with their own solar and battery.

While there are still many questions around how the data would be made useful for growers across New Zealand, it’s an exciting step towards growers understanding what diseases are floating around in the microclimate and how to tackle them before they ruin crops.

Contact: Chris.Smith@far.org.nz

BioScout uses spore-collecting sensors and AI to detect airborne disease particles.

Environmental payments changing UK arable farming

Rob Waterston at ARIA 2023.

Visiting English arable farmer Rob Waterston admits that United Kingdom farmers are "subsidy junkies", with payments for environmentally-focused plantings changing the way they farm.

Rob is farm manager for the historic Welford Park Estate at Berkshire, the backdrop for the TV series *The Great British Bake Off*. The farming operation has 670 hectares in arable with another 200ha in permanent pasture managed by a grazier under contract.

Brexit meant the end of EU subsidies to UK farmers for producing food and stock feed. But those subsidies have been replaced by payments for a multitude of on-farm environmental initiatives.

The prevalence of the invasive crop weed black-grass as well as the loss of traditional crop chemistry is also forcing UK farmers to change their rotation and management, Rob told FAR's ARIA field day at its Chertsey Arable Research site.

Since 2020, Rob Waterston has been an arable monitor farmer with the UK Agricultural and Horticultural Development Board (AHDB). His focus is reducing the use of chemical inputs and machinery while incorporating sustainable farming methods.

Welford Park's rotation is wheat, winter beans and oilseed rape, with spring barley introduced to control black-grass.

Cover crops are now grown on all land destined for spring cropping. "We get paid by the government for this. We are subsidy junkies in the UK."

Welford Park received an annual income of $71,000 for these cover crops as well as a nectar and flower mix, flower rich margins and plots, and permanent grassland. This figure rose to $95,000 with the addition of 'capital' items such as planting hedges and trees and fencing. A further $50,000 comes in each year from another fund which rewards woodland improvement and management and the restoration of park land.

"There's money there to be had, so why not have it."

Rob admits this is changing agriculture in the UK, especially as arable farmers, including himself, are struggling to grow break crops like oilseed rape and pulses. He says the last good oilseed rape harvest at Welford Park was in 2017, before access to neonicotinoid seed dressings was removed.

With farmers receiving a guaranteed income for growing a multi-species cover crop, many are now switching from a traditional break crop to a cover crop/herbal ley. Rob's cover crop of choice includes vetch, linseed, buckwheat, Berseem clover, oil radish and phacelia. However, he's not convinced that the environmental payments will go on forever.

"The worry is that we have an election next summer and with concerns about where the money is going to come from, the next government could change the rules."

He also issued a strong warning to New Zealand growers about the dangers of letting black-grass take hold.

"It will ruin your farm. Black-grass is a very intelligent plant and is now germinating all year round which it never used to do."

Pre-black grass, Welford Park's traditional rotation was winter wheat, winter barley and oilseed rape, but with black grass spriralling out of control in 2015, a lot of other crops have been introduced. The farm is finally getting black-grass under control.

Welford Park ditched the plough in 2012, replacing it with a direct drill and a strip till drill. This has led to a fifty-percent reduction in tractor hours.

"We are working towards getting the soil biology right so we can fully utilise nitrogen in the soil."

The farm is also working on ways of managing with fewer, or no fungicides. With increasing disease resistance to chemistry, a trial was carried out aimed at growing winter wheat without fungicide.

In 2021, Welford Park signed up to Agreena, a certified soil carbon offsetting scheme for farmers who use regenerative agricultural practices. The scheme provides a commercial opportunity from sequestering carbon in their soils.

The platform allows farmers to track carbon sequestration through the year and take steps to improve it. Then, once harvest is over, soil carbon storage measurements are independently verified, with certificates issued which can then be sold.

For harvest 2021, Welford Park received $82,000 for carbon sequestration. Calculations showed that emissions of 2450 tonnes CO_2e per year were offset by -4925 t CO_2e sequestered, resulting in a carbon balance of -2474 t CO_2e. Harvest 2022 looks to be significantly less.

During questions, a farmer at ARIA asked about the profitability of Welford Park's farming operation once subsidies are removed. "It's all very good having these environmental incentives, but if you're only making money because of government support there is no hope," the farmer said.

> *"It will ruin your farm. Black grass is a very intelligent plant and is now germinating all year round which it never used to do."*

Rob agreed and said growers needed a better return for grain. Average UK yields for wheat are 8.2 t/ha, so it is a challenge considering the cost of machinery and inputs.

"The farm is holding its own and historically if we have a bad year then the subsidies are your profit."

Another farmer commented that in New Zealand, the only thing farmers are rewarded for is production. "So, we are very production orientated."

Asked about which practice he would continue even without subsidies, Rob said keeping the ground covered at all times. "It stops soil drying out and encourages beneficials, but there is more slug pressure. It definitely changes the whole dynamic, but it is not easy."

SEED INDUSTRY RESEARCH CENTRE

Biological controls sought for process peas and beans

Increasing demand from consumers and markets for processed peas and beans grown with fewer chemicals is leading food company Kraft Heinz (Heinz Wattie's) to trial biological controls as a softer alternative.

In New Zealand, about 7000 hectares of peas and about 700ha of dwarf beans are grown annually for food processors Heinz Wattie's, McCain Foods and Talley's. The total value of the two crops is $30 million annually and accounts for about half of New Zealand's processed produce.

Christchurch-based Kraft Heinz senior agronomist Nigel Rowe-Lucas says that many of the markets it sells its processed vegetables to are reducing their maximum residue limits (MRL).

"The challenge we have is that they are varying internationally. Markets are moving from the international standard (Codex) and setting their own individual limits. So, it's a moving target."

Synthetic chemical options are also reducing, compounded by New Zealand's small market size and the escalating cost of development and registration. "We are not seeing new crop protection products to replace products leaving the market."

This has led Kraft Heinz, in conjunction with Process Vegetables NZ, to trial "softer" alternatives such as bio-fungicides and bio-stimulants as part of an MPI co-funded A Lighter Touch programme.

Biological products are more complex to understand and manage and differ from the conventional synthetic chemistry that growers are familiar with, Nigel told a profitable process and seed pea production field day at FAR's Chertsey arable research site.

"It is not a one size fits all and we are working with suppliers to understand the products better and how to get the best out of them and eventually incorporate these into standard production."

For example, when using *Trichoderma*, it depends on the strain and whether it is designed as a seed treatment, formulated to be applied to the soil or developing plant, or as a foliar application.

"It is not a one size fits all and we are working with suppliers to understand the products better and how to get the best out of them and eventually incorporate these into standard production."

It is likely a combination of products may be required to achieve the appropriate efficacy.

"This doesn't mean that you throw away your synthetic option. You might be able to use this still as part of an IPM programme, but at a lower use rate which allows us to meet market MRL requirements."

The good news is that there is a lot of investment going into developing new biological options, including by big multi-national agchem companies.

The Kraft Heinz programme is targeting two key fungal diseases, Fusarium root rot in peas and dwarf beans and Sclerotinia white mould, which can dramatically affect yield and quality in dwarf beans.

For *Fusarium*, a lack of chemical control options means that crop rotation is the main means of control.

Previously, four or five fungicides were available for Sclerotinia control which met overseas market requirements, "but we are now down to one".

Among the range of biological products being trialed are: *Trichoderma atroviride, Bacillus amyloliquefaciens* and SAR (Systemic Acquired Resistance) products. These are being applied either as a seed treatment, a soil/basal plant application (post emergence) or pre-row closure, pre-flowering and mid-flowering.

"SAR products are like a vaccine for plants, pre-priming the plants ahead of a challenge from an invading pathogen."

In year one (2022-23) of the trials, which were conducted by Plant & Food Research, two replicated small plot field trials were carried out on grower properties in Canterbury. In peas, 18 treatments were assessed, 8 seed-applied treatments and 10 treatments applied post-emergence to the soil/base of the plant, as well as an untreated control.

In dwarf beans, 15 treatments were assessed along with the untreated control, with treatments applied either at pre-row closure and/or pre-flowering and mid-flowering.

In the trials, some treatments showed promise under significant disease pressure.

"We are throwing a reasonably wide net over multiple options initially to see what provides a positive response."

In year two (2023-24), repeat trials are being carried out with the most efficacious products and combinations, as well as possibly assessing further products. In peas, 13 treatments are being trialled, 5 seed-applied treatments, 7 treatments applied post emergence to the soil/base of the plant and one combination treatment. In dwarf beans, 13 treatments are also being assessed, including two in combination.

Further work over the following two to three seasons will involve demonstration trials and grower focused extension using the most efficacious products and combinations identified.

Trichoderma

Kraft Heinz is also in the fourth year of an in-house *Trichoderma* trial programme using *Trichoderma atroviride* strain LU132 (Platform Seed). In these trials the biological product is commercially applied in addition to the standard seed treatment.

Results from the third year show some positive yield improvement, but there is variation in the results when used on peas, autumn-sown broad beans, dwarf beans and baby carrots.

Fertility requirements

Pea yields can be highly variable and there is still the perception that insufficient fertility is an important factor, Nigel says.

Previous research, which is now very historic, suggests that peas do not respond to applications of N, P, K, molybdenum fertilisers or lime. However, it has now been shown that significant amounts of phosphorus are needed, for example, for root development, nodule development and an energy source for N-fixation. Potassium is necessary for proper nodule development and function. Sulphur is essential for protein production and linked to nodulation and N-fixation.

Rhizobial nodulation

Kraft Heinz have a long process pea planting programme, running from July to December, with variation in geography, paddock history and weather conditions.

Rhizobial nodulation and N-fixation in peas is influenced by temperature (optimum 20-25 deg C) and the soil mineral N level.

While there are a high number of rhizobial strains in soil, research is looking at which are the most active and whether these are providing enough N-fixation to meet crop needs. This will also demonstrate the actual N benefit of peas in crop rotations, which is becoming critical with an increased focus on N budgets.

Initial trials conducted last season in conjunction with Process Vegetables NZ and Plant & Food Research highlighted the likely influence of soil mineral N and sulphur on effective nodulation and N-fixation, as well as a possible influence of cultivar. The trials also highlighted the significant amount of N that is available to a following crop in unharvested pea biomass as well as the harvested peas themselves.

Further trials are being carried out this season over more sites to assess the influence of soil mineral N, sulphur and cultivar on nodulation and N-fixation.

Kraft Heinz senior agronomist Nigel Rowe-Lucas addresses the field day.

SIRC
SEED INDUSTRY RESEARCH CENTRE

Trichoderma-based seed treatments for pea seed production

Key points

- In SIRC-funded trials, Trichoderma-based seed treatments are showing promise as alternatives to fungicide seed treatments currently used as industry standards for protection of pea seed crops from *Aphanomyces*.
- *Trichoderma* seed treatments were also compatible with the fungicides used on seed.
- *Trichoderma* seed treatments resulted in reproducible colonisation of soil and plants and suppression of pathogen load. Yields have also shown some improvement.
- Three more *Trichoderma* seed coating trials are underway in 2023-24 to understand their reliability.

Background

Aphanomyces root rot is a major limitation on the frequency peas can be grown within arable rotations, as the spores are long lived in the soil. A rotation of peas back into the same paddock is typically at least five years, more commonly closer to 10. A variety of legumes host *Aphanomyces*, which further reduces crop rotation options. Common arable weed species such as spinach, field pansy, chickweed and Shepherds purse are also hosts.

Fungicide seed treatments are used to manage *Aphanomyces* in peas. However, variable efficacy of seed treatments and increasing requirements to reduce chemical use in vegetable seed crops have led the industry to find biological alternatives. A project funded by the Seed Industry Research Centre (SIRC) is investigating the use of *Trichoderma*-based seed treatments to suppress disease and to protect or enhance yield.

Trial results

Two plot trials have been conducted over the last two seasons in peas. Results from the first, conducted by Lincoln University, showed *Trichoderma*-based seed treatments increased the rate of plant establishment, leading to improved green pea and seed yield compared to an untreated control. The *Trichoderma*-based treatments also produced comparable or better results than the industry standard fungicide (WAKL) treatment.

Greater host resistance to *Aphanomyces* and *Fusarium* (another production-limiting pea pathogen) were observed as lower incidence rates in treatments containing *Trichoderma* seed treatments.

The second trial, run by FAR at the Kowhai site, was more variable.

Trichoderma was present at a significantly higher rate in both the soil and roots of treatments grown from *Trichoderma*-treated seed when compared to those where *Trichoderma* was not used.

2023-24 trials

Three more *Trichoderma* seed coating trials are underway in peas.

Two are at FAR's Kowhai Farm, where one is re-planted into last year's trial, and the other is adjacent to it in an ex-barley block.

The third trial is within a high-grade seed block. It has shown no relationship between establishment rate and seed treatment, and has very little disease pressure so far.

Summary

Trichoderma seed treatments have been shown to reduce the incidence of *Aphanomyces* and *Fusarium* root rots and increase yield over the bare seed control in pea seed crop trials. Yield has been generally comparable to WAKL fungicide seed treatments. When *Trichoderma* and WAKL are combined it does not appear to affect the *Trichoderma* negatively and in some cases a (non-significant) increase in yield over *Trichoderma* treatments alone has been observed.

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SIRC
SEED INDUSTRY RESEARCH CENTRE

Vulpia and broomrape in seed crops

Sean Weith, left, and Nick Davies.

Key points: Vulpia hairgrass

- Vulpia hairgrass is a common and problematic grass weed in ryegrass seed crops.
- Treatments applied prior to ryegrass emergence achieved the best Vulpia hairgrass control.
- Treatments containing Nortron® applied at pre-emergence of grass weeds, or Prominent® applied at post emergence of the ryegrass, generally achieved highest levels of reduction in Vulpia hairgrass with good levels of crop safety.

Managing Vulpia hairgrass in ryegrass

Vulpia hairgrass is a common and problematic grass weed in ryegrass seed production, impacting both yield and quality. The primary herbicide used to control Vulpia hairgrass in ryegrass seed crops is Nortron® (active ingredient (a.i.) 500 g/L ethofumesate, Group 15 Herbicide). The use of Nortron® in crops like ryegrass poses a significant risk of resistance developing in common grass weed species, especially if applied following cereal crops treated with Firebird® (a.i. 400 g/L flufenacet + 200 g/L diflufenican, Group 15 Herbicide + Group 12 Herbicide), since the actives in both herbicides share the same mode of action (Group 15).

To combat resistance in Vulpia hairgrass, it is essential to incorporate herbicides with diverse modes of action and integrate them with other effective weed management practices. Therefore, it is crucial to identify herbicides that can be used as alternatives to Nortron® that are capable of effectively controlling Vulpia hairgrass at various growth stages in ryegrass seed crops. Previous FAR trials (2018-2019) showed that Nortron®, applied at the 2-leaf stage of Vulpia hairgrass (Zadok's growth stage (GS) 12), was moderately effective, but less effective when applied later. Therefore, the main objectives of this work were:

1. To assess the effectiveness of various pre- and post-emergence herbicide options for Vulpia hairgrass control in ryegrass seed crops.
2. Identify herbicides that could be used as potential alternatives to Nortron® for controlling Vulpia hairgrass in ryegrass seed crops at different application timings.

2023-24 trial details

Treatments were applied at two different timings, either at the pre-emergence of ryegrass (GS 00- 07) (T1), 27 April 2023, or when 50% of plants were at 2-leaf stage (GS 12) (T2), 12 June 2023.

Results

Overall, the highest levels of efficacy were achieved by the treatments that were applied at the pre-emergence timing of the ryegrass. Nortron® applied at the pre-emergence stage solo at 4 L/ha (Treatment 2) or followed at early post emergence with either 2 L/ha of Prominent® (Treatment 4) or 4 L/ha of Asulox® (Treatment 5) achieved the highest levels of Vulpia hairgrass control with acceptable levels of crop safety for the ryegrass. Splitting the 4 L/ha application of Nortron® into two separate 2 L/ha applications with Prominent® applied at 2 L/ha (Treatment 9) at timing 2 also provided satisfactory levels of Vulpia hairgrass control and ryegrass crop safety, indicating the value of using Prominent® early after emergence of ryegrass. Applying Prominent® at 2 L/ha in a tank mix with 4 L/ha of Nortron® during pre-emergence (Treatment 3) or with 500 mL/ha of Atraflow™ and 80 g/ha of Sakura® (Treatment 16) post emergence effectively controlled Vulpia hairgrass. However, these treatments caused significant (P≤0.001) reductions in the number of plants in treated plots due to the considerable phytotoxicity damage to ryegrass. It is likely that this damage will persist through to flowering resulting in low numbers of ryegrass seed heads being present at harvest causing yield to be heavily impacted.

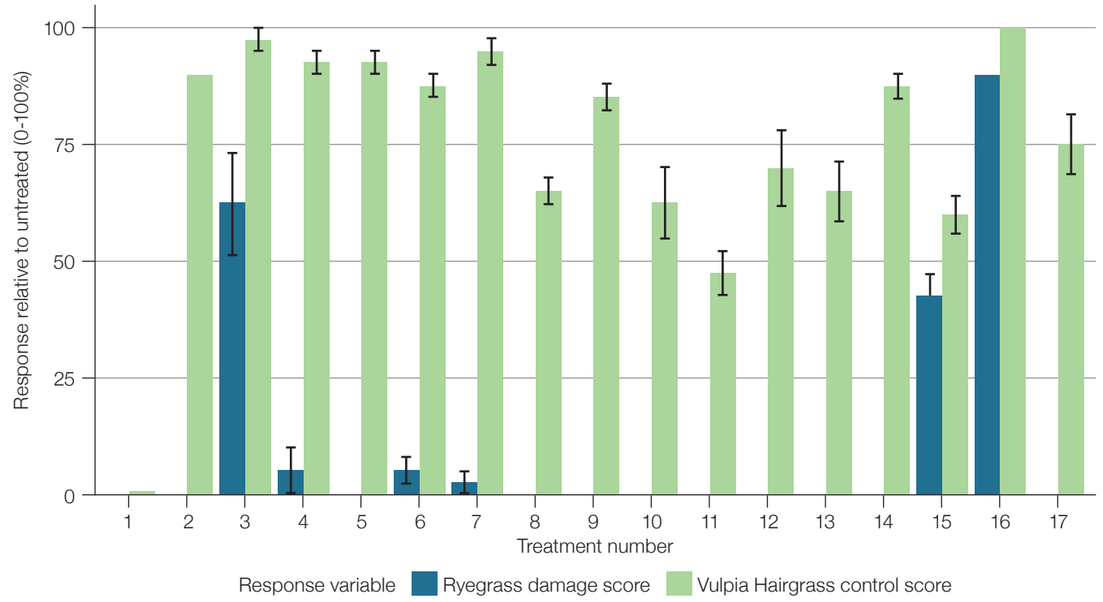

Figure 1. Ryegrass damage and Vulpia hairgrass control scores relative to the untreated control (Treatment 1) 10 weeks after application of pre-emergence herbicide treatments on 25 August 2023.

Key points: Small broomrape

- The parasitic weed small broomrape is becoming an increasing issue in clover seed crops.
- Chemical control options for small broomrape are limited.
- A model was able to predict the emergence of broomrape plants to within a week, for sites between Ashburton, Rakaia and Methven.

Nick Davies examines small broomrape.

Control of small broomrape in clover

Background

- The parasitic weed small broomrape is an increasing issue in clover seed crops.
- Small broomrape is a notifiable weed in some countries, e.g. USA.
- It is becoming hard for seed companies to find crops which pass field inspection for some markets, particularly South America.
- Small broomrape spends most of its lifecycle below ground where it undergoes germination, penetration of the host, vascular connection and acquisition of nutrients.
- A single plant is capable of producing 500,000 seeds and seed may remain viable for up to 50 years in the soil.
- Small broomrape seed will not germinate without a host or "false host" plants present.
- While several "false hosts", including wheat, ryegrass, barley, oats and tall fescue, can trigger germination, broomrape is incapable of sustaining growth on these species, thus reducing the soil seed count. However, relying on this method as an effective strategy for controlling broomrape is not recommended.
- Mature flower stalks are typically 10 to 50 cm tall and do not contain chlorophyll (Figure 2).

Strategies for controlling small broomrape in clover seed crops

Chemical control options are limited. Soil applied herbicides have little effect as small broomrape sources its nutrients and water from the host plant. Similarly, herbicides which attack photosynthetic pathways are ineffective, as broomrape does not photosynthesise.

Realistic control options, if terminating the crop, include glyphosate, paraquat/diquat and ALS inhibitors (imidazolinones and sulfonylureas). In clover crops, imazamox and imazamox plus bentazon have shown some promise in limiting emergence and being crop safe. However, imazamox is not available in New Zealand.

A growing degree day model has been developed in Oregon for small broomrape parasitising red clover crops to optimise herbicide timings.

We have no hard data on crop loss from infection, but it is not believed to be large in healthy irrigated crops. Crops under stress (e.g. dryland) may exhibit more substantial losses.

Small broomrape inflorescence emerging, November 2022, near Chertsey.

Observations of small broomrape in clover during the 2022-23 season in NZ

- The model predicted the start of emergence to within a week for sites between Ashburton, Rakaia and Methven.
- Small broomrape was first reported near Chertsey in early November.
- Additional reports came throughout November, mainly in second year clover crops.
- First mature seed found 22 December 2022. Literature suggests that if it has started flowering, it doesn't matter what you do, even if it is cut off it will still produce viable seed.
- Monitoring continued until February when crops were desiccated, both paddocks still had inflorescence emergence occurring.
- The control window appears to run from late October though to at least January.

Trial at Chertsey arable site, 2023-24

Seed was spread last season over the clover trial. Equate® (active ingredient (a.i.) imazethapyr) and Preside™ (a.i. flumetsulam) were chosen as they are the most closely related chemistries to imazamox available in New Zealand. Oregon's growing degree model was developed to identify a herbicide application window, as literature suggests that chemistry must be applied well before emergence to be effective.

Sean Weith, Matilda Gunnarsson (FAR) and Nicholas Davies (AgResearch)

Moisture probe demo

Farmers can follow and compare the readings of different soil moisture probes following the installation of a demonstration site at FAR's Kowhai Farm at Lincoln.

FAR technology manager, Chris Smith, says that the project aims to look at the various soil moisture monitoring services commercially available to arable growers.

Nine different providers are represented. Growers are invited to log in to any of the providers' portals to check out what moisture probe readings look like on the companies' software platform. "By familiarising yourself with each one, you will see how easy it is to understand the information that is used to make management decisions."

Moisture probes are a valuable tool for managing the timing and application rate of irrigation, particularly at critical growth stages of a crop's development, Chris says.

Multi-level probes add an additional benefit for monitoring the movement and penetration of moisture in the root zone after a rain or irrigation event.

Growers are encouraged to use moisture probes as part of their best practice for the irrigation audit process. "This is so they have evidence to justify application rates or timings and prove that they are not creating potential leaching issues from over-applying, as they can illustrate they are keeping the moisture within the root zone."

Most probes also monitor soil temperature, which is useful at the shoulders of the season to make sure any irrigation events don't cool down soils too much. Both temperature and moisture are also critical measurements for fertiliser applications or planting timings.

Probes can be calibrated, but it is important to realise most show a trend in a farm's soil, getting proportionally drier or wetter in the root zone or at different depths within the soil profile, Chris says.

"It is arguably of greater value to have the field capacity and stress point for that specific probe set up correctly, taking into consideration the soil type, crop type and adjusted for growth stage (root zone depth).

"That is why moisture probes should be installed by the providers, adjusting the graphs once the probe has bedded in and had a decent weather event. This is also the reason it is best to install them in winter, when setting these parameters is much easier, because of the opportunities to reach field capacity."

The providers are: Agri Water Services, Crop X, Halo Systems, OnFarm Data, Harvest Electronics, PGG Water, Primary Insight, WaterForce and Vantage NZ. The season's results will be reviewed in June each year.

Farmers can access the moisture probe providers' portals and logins on the FAR website at https://www.far.org.nz/research/research-resources/moisture-probe-trial-at-kowhai.

Chris.Smith@far.org.nz

FAR's Chris Smith discusses the soil moisture probe demonstration at FAR's Kowhai Research Site, Lincoln.

Tine weeding in spring barley

A worrying increase in weeds becoming resistant to herbicides has led FAR to trial the use of a mechanical weeder as an alternative control in arable crops.

FAR researcher Matilda Gunnarsson says that over the past five years, FAR, in collaboration with AgResearch, has carried out surveys on randomly-selected arable farms across New Zealand to determine the extent of herbicide resistance. These surveys found herbicide resistant grass weeds were common.

Five years ago, 14 weeds in New Zealand were identified as herbicide resistant; this has since increased to 21 weeds.

“The number of weed species is not the most worrying aspect, it’s the frequency of resistance on farms.”

In almost all cases ryegrass is resistant to Group 1 and 2 mode of action herbicides.

Resistance is a bigger problem in districts where grass seed crops are grown and rotation options are limited, with 71 per cent of arable farms sampled in South Canterbury showing resistance compared with 40 per cent in Mid Canterbury and 11 per cent in the lower North Island.

A tine weeder is used to weed a spring barley crop at the Kowhai Research site

Five years ago, 14 weeds in New Zealand were identified as herbicide resistant; this has since increased to 21 weeds.

Mechanical weeding has traditionally been a tool used by organic growers, but in the last few years it has been increasingly adopted by conventional farmers, particularly in the United States and Europe, as chemical options become limited or are no longer effective.

To assess the potential role of a tine weeder on New Zealand arable farms a trial is being carried out in spring barley at FAR’s Kowhai Research site at Lincoln. The tine weeder is being trialed both in isolation and as a component of an herbicide-based weed control strategy.

Of the 10 treatments, five received no tine weeding and the other five as needed. Two different sowing dates were used, September 1 and later on September 21 to encourage another flush of weeds. Plots received a range of treatments including no herbicide, glyphosate pre-sowing, and pre and post-emergence herbicide.

The best timing for weeding is around midday on a sunny, windy day, so the weed seedlings dry out and die off. The success of a tine weeder depends on its angle, depth and speed, Matilda says. The faster the tine weeder is driven, the greater its performance power and success in controlling weeds. However, travelling at higher speeds poses a greater risk for the crop.

Contrary to popular belief, uprooting of weeds is not actually the main method of control. “It’s actually throwing soil on them. The success of a tine weeder in controlling weeds is primarily accomplished by it burying the weeds in soil at the cotyledon stage (50-70 per cent) in addition to pulling the weeds out of the ground (30-50 per cent).”

Matilda says that with herbicides, the knowledge comes in the can. “But with mechanical weeding it will be a learning curve and mistakes will be made. It will be different in every soil, crop and weed spectrum. So, it is a matter of trial and error and building your experience.”

At a field day at Kowhai, an Einbock SportStar tine weeder was demonstrated by Charles Merfield (Merf), the head of the BHU’s Future Farming Centre at Lincoln. He says that mechanical weeders, up to 20m wide, are now used extensively in Europe and America. “There is a huge amount of knowledge and expertise that has been developed.”

Mechanical weeding also extends the weed management window in terms of weather and soil conditions. “Controlling weeds with a tine weeder is ideal in windy, northwesterly conditions. If it is too wet for a tine weeder, then you have the herbicide option.

“With mechanical weeding it will be a learning curve and mistakes will be made. It will be different in every soil, crop and weed spectrum. So, it is a matter of trial and error and building your experience.”

“The earlier farmers start using mechanical weeding as a replacement for one, two or three herbicide applications the more they will keep herbicide resistance at bay on your farm.”

Below: Charles Merfield (Merf), the head of the BHU’s Future Farming Centre at Lincoln demonstrates an Einbock SportStar tine weeder at a FAR field day while Matilda Gunnarsson (by tractor wheel) looks on.

SEED INDUSTRY RESEARCH CENTRE

Downy mildew disease management in cocksfoot

It is critical that growers avoid repeatedly using fungicides with the same mode of action to prevent downy mildew resistance. Instead, mix or alternate different active ingredients and modes of action for better control.

Background

Since an oomycete was identified as the cause of potentially significant seed yield losses in cocksfoot about two years ago, trial work has focused on an optimum treatment programme.

Over the past four years, the Seed Industry Research Centre (SIRC) and FAR conducted numerous trials to pinpoint the cause of head bleaching and seed yield losses reported by growers.

The oomycete *Sclerophthora cryophila*, which causes downy mildew, has been affecting cocksfoot crops over the last four years by inducing head bleaching symptoms which are often associated with significant reductions in seed yield.

This oomycete was not previously observed in New Zealand, but it is known to infect cocksfoot in other global regions. Oomycetes are difficult to control, but in recent fungicide trials, seed yields were increased three-fold with treatments incorporating a range of fungicide products.

In 2022-23 fungicide trials, most evaluated products showed efficacy against downy mildew and leaf fleck (*Mastigosporium rubicosum*), except treatments with Curfew® (450 g/kg cymoxanil, Group 27 fungicide) and Dithane™Rainshield™Neo Tec (750 g/kg mancozeb, Group M3 fungicide).

Treatments incorporating Phoenix® (500 g/L folpet, Group M4 fungicide), Ridomil® Gold MZ WG (40 g/kg metalaxyl-M + 640 g/kg mancozeb, Group 4 fungicide + Group M3 fungicide), Pristine® (252 g/kg boscalid + 128 g/kg pyraclostrobin, Group 7 fungicide + Group 11 fungicide) and Foschek® (400 g/L phosphorous acid, Group P07 fungicide) consistently achieved higher machine dressed yields when applied at multiple growth stages.

Treatments applied at ear emergence and flowering showed the highest yield, emphasising the importance of applying fungicides during the flowering stage.

A breakthrough only occurred when growers submitted samples to Mark Braithwaite at Plant Diagnostic who identified, after validation by Eric McKenzie at Landcare Research, that the pathogen responsible was not a fungus, but an oomycete pathogen named *Sclerophthora cryophila* (*S. cryophila*).

Sclerophthora cryophila was initially identified on cocksfoot in Canada, exhibiting symptoms resembling frost damage in infected field plots. Remarkably, despite this early observation in 1955, there has been no documented global occurrences of *S. cryophila* infecting cocksfoot since its initial identification. It is probable that *S. cryophila* has been present and gone unnoticed in New Zealand for an extended time.

Generally, downy mildew has presented on susceptible cocksfoot plants with light yellow to tan lesions which can appear as bands on leaves and reproductive stems a few days after flowering (GS 60-69). Over time, these lesions grow larger and eventually result in the upper stem becoming bleached.

Furthermore, over the last four growing seasons, growers have reported that the severity of symptoms appear to be exacerbated during seasons where damp/wet conditions prevail late in the crop lifecycle.

Fungicides grouped under FRAC mode of action groups 4, 11, 21, 22, 27, 28, 29, 40, 43, 45, and 49 have shown varying levels of effectiveness against pathogens within the downy mildew disease complex in crops such as grapes, onions, and potatoes. However, their performance against *S. cryophila* in cocksfoot is limited.

Work undertaken by SIRC and FAR during the 2021-22 season showed that Phoenix® fungicide (active ingredient (a.i.) folpet, Group M4 fungicide) and Bravo® WeatherStik® (a.i. chlorothalonil, Group M5 fungicide) were efficacious against *S. cryophila*, whilst other commonly used fungicides in cocksfoot demonstrated limited or no effectiveness.

While Phoenix® can be used in cocksfoot, the use of Bravo® is either prohibited or being phased out in Europe and New Zealand, with no grazing of crops allowed after application.

Finally, it is also important to consider that *S. cryophila* may develop resistance to commonly used fungicides over time, posing a challenge for future disease control.

2022-2023 fungicide trial

Two independent small plot trials were established during the 2022-23 season in Mid Canterbury. One trial was located in a three-year-old cocksfoot seed crop in Methven and the other in a seven-year-old cocksfoot crop near Wakanui. Eighteen treatments were trialled.

Seed yield was obtained by windrowing plots and harvesting all treatment plots with a plot harvester.

To calculate the margin-over-cost (MoC), the treatment cost per hectare and cost per application were subtracted from the revenue generated per hectare for each plot. This calculated amount was then further subtracted from the cost per hectare of the untreated control. Calculations were based on a grower's seed price of $5.25/kg.

The downy mildew disease pressure varied between the trials, with low pressure at Wakanui and moderate pressure at Methven. However, notable disease pressure from leaf fleck disease, caused by *Mastigosporium rubicosum*, was also present at both trial sites throughout the growing season.

The lower downy mildew pressure can be attributed to the dry weather conditions during early spring, transitioning to wetter conditions in November and December 2022. This resulted in a reduced risk of downy mildew infection compared to previous FAR field trials in spring.

When the results from the Methven and Wakanui trials are considered together, it is clear that the treatments that included either Phoenix®, Ridomil® Gold MZ WG, Pristine® or Foschek® were the most effective, especially when applied at specific growth stages.

On the other hand, Treatment 16 (Curfew® at 350 g/ha + Dithane™Rainshield™Neo Tec at 210 g/ha) didn't perform as well in both trials.

While there were no big differences in seed yield among treatments, it's important to note that some treatments had lower potential seed yield after flowering, especially in Methven, due to damage inflicted by late-season diseases such as leaf fleck.

In both of these trials, Treatments 4 and 5 (Phoenix®) were the most profitable in Methven and Wakanui, respectively. However, it is important to note that the economic benefit of the treatments in the Wakanui trial was lower because there was less disease pressure than in Methven.

Conclusion

Lower levels of downy mildew pressure were experienced in both trials, however, late-season disease pressure from leaf fleck and other diseases affected seed yield following flowering.

Most evaluated products showed efficacy against downy mildew and leaf fleck, except for treatments containing Curfew® and Dithane™Rainshield™Neo Tec.

Treatments incorporating Phoenix®, Ridomil® Gold MZ WG, and Pristine® consistently achieved higher machine dressed yields when applied at multiple growth stages.

Treatment profitability varied across treatments and trials, with the lower disease pressure in the Wakanui trial resulting in the applied treatments having a relatively low economic benefit compared to treatments applied in the Methven trial.

Further considerations

In other species, downy mildews have developed resistance to commonly used fungicides. Thus, it is important to proceed with caution and not to apply products from the same mode of action (MoA) groups repeatedly in the same paddock.

Ideally, a specific active ingredient (a.i.) should be mixed with another active ingredient from a different MoA that also has activity against the pathogen, or at the very least MoAs should be alternated at sequential timings.

Currently, the best knowledge is to assume that an active ingredient with activity against oomycetes has activity against *Sclerophthora cryophila*, the causal agent of downy mildew of cocksfoot.

The further identification of new alternative products from a range of MoAs is one of the focuses of this season's (2023-24) trial work.

Richard Chynoweth, Emelia Cox and Sean Weith, FAR

Crop competition to manage weeds

Key points

- Weeds are causing potential losses of up to 35% of global crop production.
- Enhancing the capacity of wheat to compete with weeds offers a cost-effective solution without requiring farmers to adopt new techniques or equipment.
- Faster canopy closure is associated with the capacity of wheat to compete with weeds.
- Light interception measurements in the Chertsey CPT trial (2023-2024) show that different cultivars have significantly different rates of canopy closure from early growth onwards.

Background

Weeds are a significant challenge in global wheat production, competing with the crop for essential resources and causing losses of up to 35% of global crop production. While the current agricultural system manages to keep weed pressure within 10% of yield loss, it comes with its own set of problems, including herbicide resistance, soil erosion, and the presence of chemical residues in food and water. The cost of herbicide resistance, coupled with increasing legal constraints on pesticide development, emphasises the need for integrated weed management.

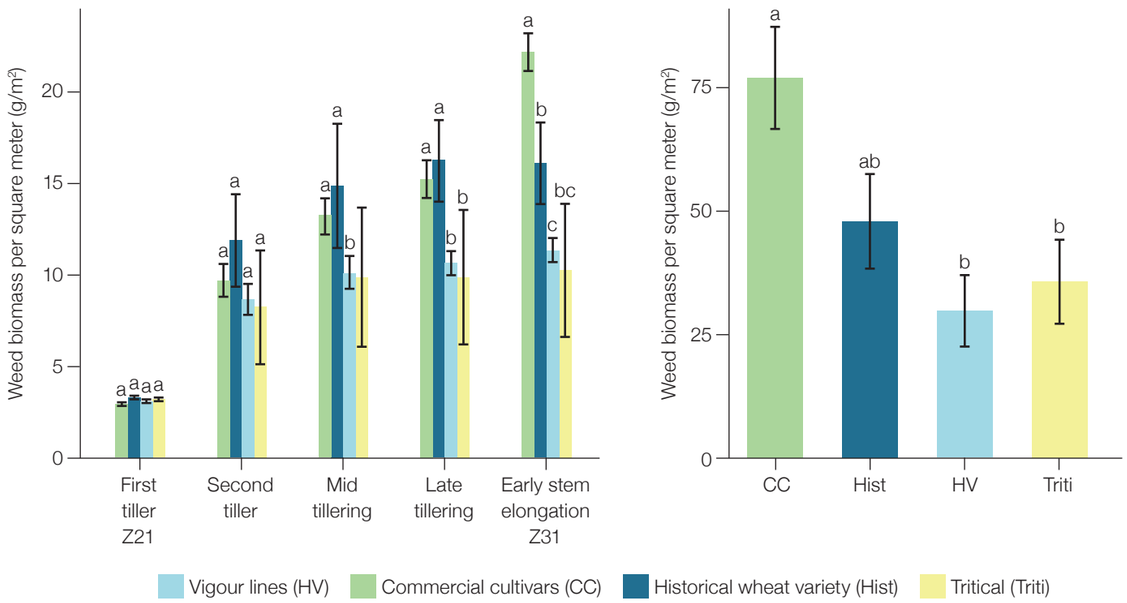

Figure 1. 2020 Field trial results (Australia) showing weed presence and biomass under vigour lines (HV, ligh blue) compared to five commercial cultivars (CC, green), a historical wheat variety (Hist, dark blue), and triticale (Triti, yellow).

Historically, wheat had the advantage of shading out weeds due to its tall growth, but this came with risks of lodging and reduced harvest index. The Green Revolution focused on increasing yields and reducing above-ground biomass and leaf area, which inadvertently reduced crop competitiveness with more open canopies allowing more light penetration and weed growth. Additionally, modern wheat cultivars have smaller root systems, further impacting their competitiveness against weeds.

Enhancing the capacity of wheat to compete with weeds offers a cost-effective solution without requiring farmers to adopt new techniques or equipment. Crop competitiveness is the combination of crop tolerance to weed competition and its ability to suppress weeds.

Wheat cultivars that close their canopy faster and shade out weeds are more competitive. Notably, the development of early shoot vigour in wheat has been successful, increasing leaf width and area, which aids in faster canopy closure and weed suppression. These differences in light interception account for approximately 50% of the increased suppressive ability of the vigorous lines.

Testing New Zealand-grown wheat cultivars

FAR and Lincoln University are investigating whether it is possible to detect differences in light interception in the early stages of growth in New Zealand wheats. To do this, we are initially comparing cultivars/lines in the CPT2 trial at the Chertsey Arable site. Results collected to date suggest some significant differences in light interception from early growth onwards.

Pieter-Willem Hendriks (Lincoln University) and Matilda Gunnarsson (FAR)

FAR recently gave some of MPI's SFFF team the chance to look around two arable farms in Wairarapa. The group were hosted by Henry and Pascoe Reynolds before moving on to meet Richard, Thomas and Martina Kershaw (pictured). They saw a range of cereal and specialty seed crops, and had interesting discussions around farm and regional infrastructure, biosecurity and a range of other arable issues.

ARIA

Arable Research In Action 2023

The fungicide-cultivar weed clock attracted lots of attention at ARIA, as did the talk on harvest losses. There was also a lot of interest in the management of multi-year grass seed crops. FAR graduate Emilia Cox received recognition from Board Chair Steven Bierema.

AIMI
Arable Industry Marketing Initiative

Maize

The AIMI maize survey (to 31 October 2023) reports on:

- Grain and silage sowing intentions for the current season
- Final figures for the 2023 harvest of maize grain and silage
- Sales of the 2023 harvest of maize grain since June 1, 2023
- Levels of unsold maize grain from the 2023 harvest

The report notes that a wet spring in the east and north of the North Island has delayed some sowings by up to four weeks, and that the total maize grain area for the 2023/34 season is likely to be 5% higher than last year, while the maize silage area is likely to reduce by around 6%.

Key points

- Spring 2023 sowings and sowing intentions for maize grain, were estimated to be up 5% on the area harvested last season. Sowing was only 51% complete (versus the 9-year average of 74%) and an estimated 43% of the 2024 maize grain harvest had been sold forward.
- For maize silage, spring 2023 sowings and sowing intentions were estimated to be down 6% on the area harvested last season. Sowing was only 55% complete (versus the 9-year average of 68%) and an estimated 74% of the 2024 maize silage harvest had been sold forward.
- The average maize grain yield for the 2023 was 9.8 t/ha, down on the previous season (11.5 t/ha). The final average yield of maize silage was 19.0 t DM/ha, down from 20.9 t DM/ha the previous year. However, it is important to keep in mind that these figures are national averages and there will be differences across regions, especially in areas affected by Cyclone Gabrielle and other weather events across the North Island.
- The estimated 168,300 tonnes for the maize grain 2023 New Zealand harvest was 11% down on last season's harvest tonnage (188,200 t), as a result of a reduced yield (down 15%) for an increased harvest area (up 5%). An estimated 99.6% of the total crop had been sold as at October 31, 2023, as compared to 93.8% sold as at June 1, 2023. This corresponds to a reduction in unsold tonnage from 10,000 t on June 1, 2023 to 600 t on October 31, 2023. The unsold tonnage on 31 October, 2022 was similar, at 700 t. (Note that stocks held by merchants were not considered here).
- For maize silage, the estimated 1,050,300 tonnes DM for the 2023 New Zealand harvest was down 7% on last year (1,128,000 t DM). This was a result of a decreased yield (down 9%) for an increased harvest area (up 3%).

Cereal

The 2024 cereal harvest is predicted to be down 3 per cent in terms of hectares sown, according to the latest Arable Industry Marketing Initiative (AIMI) report.

The October cereals report shows that planted hectares for wheat, barley and oats are estimated to be 94,300ha, down 2,900ha on last season.

The 2024 harvest hectares for feed wheat and feed barley are predicted to be 1,500ha and 3,400ha lower than the 2023 harvest, respectively, while for milling wheat and malting barley the 2024 harvest hectares are predicted to be 600ha and 1,100ha higher.

The report represents the responses of 145 growers regarding cereal areas and volumes.

When compared with the same time last year, unsold stocks of cereal grain are estimated to have more than doubled (105 per cent higher). In October, unsold stocks of feed wheat were estimated at 32,900 tonnes (up 15,000t on last year) and feed barley 53,500t (up 29,800t on last year).

On-farm storage of sold grain is up 55 per cent (up 90,300t) on the same time last year. Total on-farm storage, including both sold and unsold grain is up 67 per cent (up 147,500t). Survey commentators report that contracted grain is slow to move. The low dairy payout has led to a flat market for feed grain, although there was some movement due to a cold, wet spring slowing pasture growth.

With not many contracts around and uncertainty around what prices will do in the future, some growers have cut back sowings. Some aren't growing this season due to predicted El Nino impacts, expected to result in a dry summer on the east coast.

Total cereal grain production in the 2023 harvest was about 1 million tonnes, made up of an estimated 835,900t of wheat, barley and oats (up 9 per cent on last year) and 164,400t of maize grain.

AIMI receives funding from the Ministry for Primary Industries (MPI), FAR, Arable Food Industry Council, NZ Flour Millers Association, NZ Feed Manufacturers Association, Federated Farmers and United Wheat Growers.

FAR®

Statement of Service Performance 2023

FAR's external audit process has been extended beyond financial performance to include a number of non financial metrics. This Statement of Service Performance outlines progress against a number of strategic company goals and will now be completed annually.

The Foundation for Arable Research (FAR) is an applied research organisation funded by and responsible to New Zealand arable growers. FAR invests in research, development and extension to support positive change in the arable industry.

For many years, the focus of FAR's research was on driving productivity in the sector, with New Zealand growers recognised internationally for the quality and yield of their grain and seed crops. However, consumers are now demanding that food production must also be environmentally sustainable and this has necessitated a change; away from high input systems and toward ones that are lower input, more diversified and more resilient.

FAR has responded to these external drivers with a revised strategic direction that aims to:

- Enhance the profitability of arable farm systems while protecting and enhancing the natural environment.
- Support capability building in the arable sector to ensure a foundation of skilled, fit for purpose growers is available to meet the sector's future needs.
- Work with other sectors to address national environment challenges and explore integrated farm systems that enhance the profitability of arable cropping.
- Provide growers with new knowledge, technologies and tools that deliver on-farm efficiencies and innovations for enhanced profitability and resilience.

This Statement of Service Performance reports on progress being made on four key goals that address the needs of the arable sector and deliver to FAR's strategic plan.

Goal 1

Growers are reducing their on-farm input costs and farm environmental impact through efficient management of water and nutrients.

The majority of New Zealand arable growers operate highly productive and environmentally sustainable farm systems, but there are still opportunities to improve resource use efficiencies to deliver a lighter environmental impact and lower input costs. Over the last two years, FAR's research has focused on the development of agronomic practices that optimise the efficient management of water and nutrients. Eight project plans were developed on different aspects of resource management with all projects successfully completed. A new project (Banking the Rain) focused on gaining a greater understanding of how soil and crop management can make the most of winter rain and early season irrigation. This will help growers optimise water use efficiency under current and future climate scenarios. A key output from the broader portfolio of resource management projects was the production of a grower manual that collated all of FAR's research to date on improving soil quality in an arable farm system (FAR Focus 15: Good soil is good business).

Goal 2

Arable growers are managing pests and diseases using effective crop protection technologies with a lighter touch on the environment.

The economic impact of pests and diseases poses one of the biggest risks to the profitability of arable farm systems. To address this risk, FAR has a well-established crop protection programme that includes pest and disease modelling, detection and diagnosis, pesticide evaluations and pesticide resistance management programmes. The importance placed on this work is evidenced by an annual investment of approximately 30% of the total R&D budget.

However, increasing negative public perception of agrichemicals has driven a national and global demand for food that is produced using low or no agrichemicals. This has prompted FAR to invest in more research on reduced pesticide production systems. In 2023, eleven projects were conducted that evaluated alternative strategies to agrichemical use. This represented 38% of the total crop protection programme compared to 26% in 2022. A long-term goal for FAR is to support the transition of the arable sector to a more bio-based crop protection system with targeted use of agrichemicals.

Goal 3

New value-add crop and/or business opportunities are identified to enhance the profitability of arable farm systems

The diverse nature of arable crop rotations provides the opportunity to identify and integrate new cultivars or new crops that may provide growers with greater financial returns. In 2023, FAR planned and conducted four value-add project plans (two existing and two new) and successfully progressed all of these projects. The main project evaluated the potential of growing pea and bean crops in New Zealand to produce protein extracts, to serve the burgeoning global plant protein market. Integration of either of these plant protein crops into an arable rotation has the potential to increase the gross margin per hectare for the grower.

Goal 4

FAR is delivering more effective extension and upskilling activities that provides greater value to arable growers.

Conducting research is only one component of the R&D pathway. For research to have any value, it must be taken up and used by growers to improve their farm business. Effective extension and communication are therefore key components of FAR's business. Identifying new communication pathways and engaging with a wider network of growers, particularly those in the regions outside of Canterbury, has been a priority focus for FAR over the last two years. Even with COVID related constraints, FAR has made strong progress on a number of fronts. In 2023, FAR successfully delivered 314 extension activities, compared with 281 in the previous year. Growers Leading Change, FAR's innovative knowledge exchange platform was particularly successful in supporting and upskilling regional grower groups focused on local issues. The GLC programme exceeded targets, delivering 99 extension events, a substantial increase compared to the previous year (72).

FAR continued its use of digital technology with the delivery of a second on-line maize conference (Premier Maize Event, Feb 14th 2023) and 52 episodes of the 'Cut the Crop' podcast series.

To achieve its R,D &E goals and deliver tangible benefits to New Zealand arable growers, FAR needs high performing staff across all its functional groups. The company is committed to providing a supportive and creative work environment for its staff with flexible work hours, staff training and development programmes and a strong values-based culture. The annual staff satisfaction survey provides valuable feedback on the company's performance as a good employer and we aim to achieve an average score of at least 8 (out of 10) across the three main assessment criteria (effective job support, respectfulness in the workplace and likelihood to recommend FAR as a good employer).

Service performance measures*		2022-2023		2021-2022 (unaudited)	
		Target	Actual	Target	Actual
1.1	Number of research projects focused on resource use efficiency	8	8	9	9
1.2	Delivery of major grower resource booklet	1	1	1	1
2	Crop protection projects focused on reducing pesticide use (%)	40%	38%	25%	26%
3	Number of value-add projects	4	4	2	2
4	Extension activities (events and publications)	n/a	314 176 events 138 publications	n/a	281 145 events 136 publications
5	Staff satisfaction survey – average rating across 3 main criteria (out of 10)	>8	8.4	>8	8.1

* Key judgements

In compiling the Company's Statement of Service Performance (SSP), FAR has made judgements in relation to which outcomes and outputs best reflect the achievement of its performance for the Company's mission and strategic goals. Outputs and outcomes are derived from information reported in the annual report, extension reports and internal planning documents. The SSP covers those priority areas identified by levy payers (namely resource management, crop protection, value-add cropping and innovative knowledge exchange) rather than the business as usual agronomic activities that are conducted on a routine annual basis.

2024 Nuffield scholarships

Four food and fibre sector leaders have been awarded 2024 Nuffield Farming Scholarships.

FAR vice chair Steve Wilkins, who is also a NZ Rural Leadership trustee, was on hand to congratulate the new scholars. With the number of applicants rising each year, competition for scholarships is strong.

To ensure the 2024 Nuffield Scholars can travel and gain international insights in a context of rising travel prices, the value of the scholarships increased in 2023. This has also meant that four scholars were selected this year instead of the maximum five.

Trust chair Kate Scott acknowledged the support of Rural Leaders' strategic partners, including FAR.

The 2024 Nuffield Scholars are:
Carlos Bagrie: An Otago based sheep and beef and arable farmer, Carlos will focus his research on circular farming systems that reduce waste while improving the bottom line.

Rachel Baker: A Central Hawke's Bay based agri-investments portfolio manager, and dairy farmer. Rachel's research will look at the impact of existing and proposed global food strategies on food producers.

Jenna Smith: A Waikato based Māori agribusiness CEO and dairy farmer, Jenna's research will focus on climate change related land use changes.

Peter Templeton: A Southland-based, fifth-generation dairy farmer. Peter's research interest is in the future of farming and the role of innovation.

Carlos Bagrie, Rachel Baker, Jenna Smith and Peter Templeton with FAR vice chair Steve Wilkins, centre.