Grounds for Growth

Soil and pasture biodiversity event

A first-ever for the Australian dairy industry, Grounds for Growth is a soil and pasture biodiversity event supporting farmers with adopting multi-species pastures and other practices to improve soil health and function.

Abstracts

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SESSION ONE

James Mann, SA dairy farmer & former Dairy Australia Chair

Welcome and introduction

Why are we here at this event? Because we are:

- Inquisitive
- Questioning
- Innovative

Fifteen years ago, I was what some would refer to as a 'traditional' dairy farmer, committed to increasing urea and nitrogen inputs to drive production and profitability. Since then, I've benefited from the advice and support of a great ag consultant, and the opportunity to meet a variety of farmers, all with very diverse approaches to their operations and practices, based on their particular situations.

This has really opened my mind and changed my thinking in this space.

My role with Dairy Australia has also involved engagement with government and scientists, as well as considering the New Zealand and Northern European experiences. Across the sector, there is agreement that we need to change, the question is how do we do that? We have made some progress, and momentum is building to achieve more. Our research needs to be bold and ambitious, to successfully drive the changes required.

Henry Ford said, "failure is simply the opportunity to begin again, this time more intelligently." We shouldn't be afraid to fail.

This conference provides us with the opportunity to ask the '$5 million questions'. What do we want? What's the best way to invest our levy dollar to benefit our sector?

Over the next two days we will hear from some of our best farmers, scientists, ag consultants, government and industry representatives. All working together for the benefit of our sector. Enjoy the social interaction, and remain **questioning, inquisitive and innovative**.

Brad Collins - dairy farmer, Dixie

Q&A session with MC Greg Duncan

Alongside my wife Tammy, we own and operate a 154-hectare dairy farm in Dixie and a 50 hectare out paddock in Laang, South West Victoria. We currently milk 300 Friesian cows, calving in February and March, and growing all fodder on-site. As a third-generation farmer, I have been dedicated to dairy farming since the age of 15. Over the past 35 years, my passion for the dairy industry has only grown, and I've witnessed a positive shift within the broader industry.

After 30 years of farming, I recognised the need for more sustainable practices to secure the future of our dairy farm. Taking over the farm from my parents, I initiated significant changes to ensure both sustainability and profitability. We focused on reducing synthetic fertilizers, particularly urea, and began planting chicory and clovers with a rye grass base.

Five years into our journey, we have successfully reduced urea usage by two-thirds and remained profitable. We have also made innovative investments in our farm, including new irrigation systems and a dam. These efforts have strengthened our commitment to sustainability and paved the way for a thriving, eco-friendly future.

Jack Holden - Director of Meat & Livestock Australia and Deputy Chair ADSF

What's driving the market?

In this session, we will be exploring market drivers for adoption of sustainable practices, notably soil diversity and health. Some customers have been looking for this for some time and demand is still increasing. Now investors and our own people in dairy businesses are also looking to understand more about dairy sustainability.

Most customers often have general ideas that they want more sustainable products, but they are often not across the specifics of what this includes or excludes. There may be a small slice of a market willing to pay a premium price for specific practices. However, for most of the industry sustainability is becoming one of a bundle of essentials that enable more volumes to go to higher value customers.

There is still an opportunity now to stay ahead of customer expectations and adopt sensible sustainable practices that work for our farm businesses. We want to identify the practices that both make money and improve our sustainability story. These win /win activities like better breeding, feeding and fertiliser use will make money and improve the greenhouse footprint of the products.

Customers do want to see continuous improvements. For now, they are mostly happy to be advised by producers and industry experts on what are the most relevant improvements. The Australian Dairy Sustainability Framework is one effective way of demonstrating this.

However, if we don't show progress then other, less informed, people will define it for us.

The climate focus needs to be on improving our emissions intensity, not just reducing overall emissions. This is about better margins with less impact - not about just removing cows.

And if the science on soil and pasture biodiversity shows that it improves farm margins, then it makes sense for it be also included in our toolkit. It also strengthens the sustainability story of dairy products from our pasture-based farms.

Laura Grubb - Sustainability and Engagement Specialist, Greenham

What's driving the market?

In today's fast-paced, trend-driven global market, consumer purchasing decisions are increasingly influenced by social media trends and environmental values, often determined with a quick swipe of a TikTok video. For the Australian beef industry, this shift presents both challenges and opportunities in securing a place on consumers' weekly meal plans.

To address this, Greenham developed the Greenham Beef Sustainability Standard (GBSS) to meet the growing demand for transparent and credible environmental practices. The GBSS aims to achieve two core objectives: to provide consistent, high-quality beef that aligns with customer values and to promote best practices that protect the land and communities for future generations. The program is also designed to reflect broader industry priorities, offering producers a clear pathway to sustainability initiatives like CN30.

A key feature of the GBSS is its approach to co-design, developed in partnership with customers, industry experts, and producers. This collaborative process ensures that the program not only upholds environmental integrity for consumers but also provides tangible ecological, social, and economic benefits at the farm gate. Ultimately, the GBSS is an outcomes-focused approach that delivers Australian regenerative beef to global consumers, helping shape a sustainable future for the industry.

Lynette Abbott - Emerita Professor, The University of Western Australia

Scientific rationale for adopting practices to support optimum soil biodiversity and health

Communities of soil organisms provide the backbone of healthy soils. Soil health is an interplay between biological, physical and chemical processes. The optimum characteristics of soil health differ with soil type and climate and with the agricultural production system and choice of management practices. While biodiversity is a hallmark of 'healthy soil', a sandy soil may have a lower optimal level of biodiversity than a clayey soil, due in part to differences in soil habitat structure and the capacity of soil to retain carbon.

Indeed, the abundance, diversity and functional attributes of soil organisms are tied to the underlying soil characteristics, and consequently to location-specific soil management practices. Soil biodiversity and function are also significantly influenced by plant biomass and plant diversity, which are in turn strongly influenced by soil amendments, especially fertilisers and derivatives of organic wastes. The structural complexity of organic resources in soil creates habitat heterogeneity, and this has important impacts on the diversity and function of soil organisms. Disturbances required to maintain farming systems also alter the abundance and activity of soil organisms, which can be both detrimental and synergistic. Soil nutrient cycles, as well as the loss or retention of soil carbon, depend on interactions between soil organisms and their environment, especially the status of the soil organic matter and the heterogeneity of the soil habitat which includes the stability of soil aggregates. In essence, soil health is more than the sum of its parts, and there is an additional time dimension which influences whether or not optimal levels of soil biodiversity and biological function are achieved. The creation of healthy soil supports resilience of farming systems via effective soil function, but it is not an instantaneous result of implementation of management practices that support soil biodiversity. It takes time and requires a balance between available and slow-release nutrient sources within the framework of economic risks.

The below links are free ebooks by Lyn Abbott on the principles of soil health sustainable agricultural production.

Principles of Soil Health: Sustaining profitable agricultural production

Unveiling healthy soil: Why is soil biology key to soil health?

SESSION TWO - Productivity, profitability and quality considerations

Kate Mirams and Peter Neaves - Gippsland dairy farmers

Growing interest in farming in more sustainable ways, and what we learnt from a trial on our farm investigating soil repair following laser grading, led us to take 'regenerative' practices across our whole dairy farm.

A paired bay trial with three replicates was set up on a newly lasered section of our farm in 2019, currently funded to run through to June 2026. The trial compares 'conventional' management, to 'regenerative' management.

The conventional management includes annual monoculture winter (annual ryegrass) and summer (millet) crops followed by perennial ryegrass (Matrix) and white clover, fertilised with granular Urea, Superphosphate and Potash (Potassium Chloride).

The regenerative" management includes multispecies winter and summer crops, followed by perennial multispecies pasture. Seeds are coated with minerals, microbes and worm exudates. Lime, gypsum, and fungi and microbe friendly fertilisers such as Potassium Sulphate and Guano are applied. Foliar applications of urea, trace minerals, and bio-humic soil drench are used.

We will share results from the trial including dry matter production, standard feed tests energy, protein and fibre, plus tissue testing showing nitrates and minerals. Comparisons of soil tests and soil moisture monitoring, both to 60cm, and the cost per hectare of inputs, will also be shown.

Learnings from this demonstration gave us the confidence and understanding to take this regenerative approach right across our farm. We will present the five-year journey and the impact of doing this on our whole business, from tonnes of pasture harvested, kg/ha of N, $/ha total on fertiliser, total cows milked, milk solids and EBIT and ROC.

Gillian O'Sullivan - Irish dairy farmer

Dairy farming today operates under increasing risk due to weather extremes, market fluctuations, and evolving environmental policies. Managing these uncontrollable risks while maintaining profitability requires a strategic approach to system design, cost control, and sustainability.

Our 100-cow dairy farm in South-east Ireland, situated on steep and marginal land, faces challenges such as summer droughts, market volatility and regulatory pressures. To build resilience, we focused on three key areas: climate adaptation, economic stability, and environmental alignment—placing multispecies swards (MSS) at the heart of our strategy.

1. Climate Adaptation – Weather extremes increase reliance on purchased feed, labour, and costs. Multispecies swards, incorporating deep-rooting species like chicory, plantain, and clover, improve drought resilience and pasture persistence. Unlike traditional ryegrass, MSS retain quality longer, recover faster after dry spells, and enhance soil health. Trial results showed MSS sustaining similar yields to ryegrass while reducing nitrogen inputs and maintaining high feed value.

2. Economic Stability – Market volatility necessitates a robust cost structure. By adopting once-a-day (OAD) milking and MSS, we achieved a 10c/L higher milk price while maintaining competitive milk solids (kgMS) output. MSS reduced concentrate reliance and farm input costs, leading to a stronger net margin per hectare.

3. Environmental Alignment – Ireland's agricultural sector faces pressure to reduce emissions and improve water quality. MSS require significantly less synthetic nitrogen, supporting both environmental policy compliance and long-term farm viability. Their biodiversity also enhances ecosystem services, promoting pollinators and soil regeneration.

The key takeaway: multispecies swards offer a practical, profitable, and sustainable solution for dairy farmers facing increasing risks. By prioritising resilient pastures, cost control, and genetic efficiency, farmers can future-proof their businesses while enhancing work-life balance and environmental stewardship.

Dr James Hills PhD - Senior Research Fellow, University of Tasmania

Impacts of pasture type and nitrogen fertilisation level on productivity of irrigated grazing-based dairy systems.

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Achieving high levels of growth from irrigated perennial ryegrass-based pastures [i.e., 20 t dry matter (DM)/hectare (ha)] requires considerable synthetic N fertiliser input (400 units N/ha). With limitations being placed on the amount of synthetic N fertiliser that can be used in many parts of the world (typically less than 200 units of N/ha) there is a need to examine alternatives to conventional ryegrass dominant pastures and N fertiliser levels for irrigated temperate pasture based dairy systems. Increasing the proportion of legumes in a pasture mix is one way to potentially mitigate for the reduced synthetic N applied to maintain productivity and profitability.

Aim

To investigate if mixed species pastures with high legume content can mitigate the potential detrimental effect of synthetic N fertiliser reductions on per ha pasture and milk production.

Methods

A farmlet experiment has been set up at TIA's Dairy Research facility in Northwest Tasmania over three lactations. The first lactation commenced in August 2023. The experiment will evaluate four farmlets, which differ in synthetic N fertiliser rate and pasture type (Table 1).

Table 1. Farmlet treatments.

Farmlet	N-fertiliser rate (annual)	Pasture composition (% DM basis)
1	300 kg N/ha	80% grasses (perennial ryegrass) 20% legumes (white clover)
2	150 kg N/ha	80% grasses (perennial ryegrass) 20% legumes (white clover)
3	150 kg N/ha	40% grasses (perennial ryegrass) 30% legumes (white clover) 30% herbs (plantain)
4	Negligible *regenerative agriculture focus*	40% grasses 20% summer-active tall fescue 10% perennial ryegrass 5% summer-active cocksfoot 5% brome grass

		30% legumes 30% clover (red, strawberry & white) 30% herbs (plantain & chicory)

The trial site consists of 32 paddocks of 0.92 ha each, in 8 blocks of 4 paddocks spread across the milking platform. Each farmlet had 8 paddocks randomly allocated to one of 4 paddocks in each of the 8 blocks. Twenty-nine cows were allocated to farmlets 1 to 3, and 22 cows were allocated to farmlet 4. All paddocks were fully irrigated and rotationally grazed with a new allocation provided every 24 hours. Cows were milked twice daily. A herd test was conducted fortnightly and tested for milk fat, protein and urea content. All paddocks were measured weekly as well as pre and post grazing with a calibrated rising plate meter.

Key results

Results are only available for the first year of this experiment.

There was no difference in the amount of pasture grown (mean of 20.9 tonnes of dry matter per ha) or milk produced per cow (mean of 648 kg of milk solids per cow) in each of the farmlets, but farmlet 4 produced less milk per ha and conserved more silage due to a lower stocking rate (3 cows per ha) compared with farmlets 1-3 (4 cows per ha)

Conclusions

Data needs to be collected from replicated seasons before conclusions and implications can be drawn from this work.

Danny Donaghy - Professor of Dairy Production Systems & Deputy Head, School of Agriculture and Environment at Massey University

Whenua Haumanu – nurturing the land through exploring pastoral farming

Whenua Haumanu is Aotearoa New Zealand's (NZ) most comprehensive program on the effects of contemporary and regenerative pastoral practices, across both dairy and sheep grazing systems. It is funded primarily by the NZ Ministry for Primary Industries, in partnership with Massey University, and is worth $27 million over seven years. Whenua Haumanu is the cornerstone of the NZ Ministry for Primary Industries' portfolio of regenerative agriculture projects due to its highly collaborative and cohesive partnership across universities, Crown Research Institutes, and the NZ pastoral industry.

The focus of the program is to engage strongly with farmers, and focus on their issues, and to form partnerships across the pastoral sector, and with Iwi (Rangitāne in the Manawatu region where Massey is based are a key partner). Farmlet projects at Massey (lower North Island) and Lincoln (upper South Island) Universities are linked to farm system trialling in Taranaki (western North Island), Hawkes Bay (eastern North Island), and with Ngai Tahu farms in the upper South Island.

The program started three-and-a-half years ago, and at the most concentrated research site (Massey), we are intensively monitoring multiple aspects of diverse pastures and regenerative farming practices, alongside 'contemporary' pastures and their management. The key research focus is to scientifically assess the suitability and relevance of regenerative agriculture in NZ.

A major focus of the Whenua Haumanu program is capacity building, and along with using the farmlets at Massey and Lincoln Universities to train hundreds of undergraduate students each year, to date, we have enrolled 29 postgraduate students (eight Honours and four PhD Lincoln; eight Masters and nine PhD Massey) to undertake their studies in Whenua Haumanu, with another eight PhDs expected to enrol through Massey in 2025.

SESSION THREE: Improving soil health and function

Mark Lambert - Tasmanian dairy farmer

Overview of original farming practices

Our journey into regenerative farming – first recognising I had a problem. Initial research into what others have. Stopped using the most damaging conventional fertilizers on soil life. Started spraying biological. Stepped back and watched the changes. Reached the point where we were almost organic, and thought why not give it a go? Sickness sorted out my priorities.

Introducing change. Long grazing rotation. (Once a day milking). Standing hay. Multispecies.

Observations: Dryland. Hay/Silage quantities. Soil health. Weeds. Reduced water requirements. Soil, self-composting, worm farm. I can't see my soil anymore. Regrowth speed. More on standing hay/ deferred grazing. What grazing rotation suits this style of farming?

Financial changes. Increase in milk price with being organic. Cost profile is dramatically different.

Pasture composition and soil life has changed dramatically

a. Mixed species spreading
b. Insects and birds increasing
c. Problem insects decreasing
d. The soil is softer, with higher water infiltration rate
e. Flowers have become larger part of the landscape
f. Cow behaviour has become more settled
g. Bees produce a lot more honey.

Simon Scott, Western Victorian Dairy Farmer

Improving Soil Health and Function

Farm Overview

- Regenerative and Organic
- Stocking rate 1.4 to 1.6 head/ha
- Flexible management: Grazing, stocking rate and milking regimes.

Improving soil health and function.

Biodiversity has been the most important factor to improve soil function.

- Achieved by replacing ryegrass dominant pastures with annual and perennial multispecies pastures that include a mix of legumes, herbs and grasses.

Results for the soil.

- Improved soil structure (i.e. better soil aggregation)
- More air infiltration

- Faster water infiltration
- Increased organic matter
- Better water holding capacity which extends growth in drier periods
- Reduced erosion during winter with less pugging
- Reduced erosion during summer with high plant density and biomass
- Keeps soil cooler during summer, absorbs summer rain and reduces evaporation.

Results for the plants

- Elimination of synthetic fertilizers. Synthetic nitrogen destroys the relationship between the plant and biology. Muriate of potash (potassium chloride) is 45 -47% chlorine. Great for killing microorganisms.
- Plants form a relationship with the biology, provides exudates in exchange for nutrients.
- Healthier more nutrient dense plants that are more resilient to disease and therefore insect attack. Reflected in the higher brix levels measured in plants. An increase from 3 to typically 12- 15 plus.
- Darwin effect. Plants grown in a multispecies mix will produce more than grown in monocultures. Proven by research conducted in Germany, The Jena Experiment.

The Jena Experiment

- The German Centre for Integrative Biodiversity Research
- Studied for more than 20 years
- 150 experimental plots with different combinations of grassland plots and grassland plants: plots with only one species, with two, four, eight, or sixteen species. The results show that four or more species produce more biomass with no added N than one or two with Nitrogen.

Results for the cattle

- One drench on dairy calves after weaning. None on any other stock
- No vaccines
- Very low vet bills
- Reduced lameness
- Higher body condition
- Improved conception rates: No synthetic Nitrogen in system
- Cows are more relaxed in the dairy
- Higher fat and protein test and SNF
- Maintained production near 1kgMS/KG Bodyweight.

Results for owner

- Easier system to manage
- More satisfying creating diversity for natural insect control
- More resilient system in summer, reducing workload

Results on production

- Increase in proportion of home-grown feed by 15-20%
- Less feed conserved. Lower cost making and feeding out.

Professor Helen Suter, The University of Melbourne

What's the science behind the outcomes?

Ryegrass (PRG) dominant pasture systems typical of much of southern Australia's grazing based dairies struggle to persist during the summer months without irrigation, and increasing climate variability heightens the risk of poor production and flow on effects on soil and ecosystem health, particularly on the shoulders of the growing season. One proposed solution is the use of multispecies pastures - a mixture of grasses, legumes and herbs.

Increased species diversity in multispecies pastures means they can cope with climate variability better. The diversity should boost soil health and function, but it is not known what impacts multispecies pastures have compared to typical PRG dominant pastures. We recently investigated the potential benefits of multispecies pastures across a number of commercial dairy farms in Victoria, based in the Western District, Gippsland and Northeast Victoria, in a project jointly funded through the Australian Government's Future Drought Fund and Dairy Australia. We used a paired paddock approach (one multispecies, one PRG dominant pasture on each farm both managed in the same way with equal nutrient loads and on the same soil type) and measured pasture production and quality, and soil health and soil moisture.

Climate was a major driver of total pasture production, and also of the differences seen between the pasture types. There was limited to no benefit of using multispecies during spring when conditions favoured PRG. However, in autumn and late spring, when moisture stress can occur, the multispecies provided a production benefit. In addition, the value of the multispecies feed at this time was high as it provided high crude protein and metabolisable energy when the PRG could not. The soil profile moisture indicated that the multispecies swards were able to access water from greater depths which increased their resilience. Soil health benefits were not seen but could be due to the short length of pasture establishment and the high carbon content of both systems.

Lucy Burkitt, Associate Professor in Soil Science Massey University

Whenua Haumanu: Regenerative Agriculture in New Zealand

Regenerative agriculture (RA) is increasingly being adopted in NZ, with claims that diverse pasture species and regenerative management improve soil health and environmental outcomes. A comprehensive Ministry for Primary Industries (MPI) funded seven-year farmlet study at Massey University is examining regenerative and contemporary pasture systems. The main project involves a fully funded sheep and dairy cow grazing farmlet platform which provides a unique opportunity to research the influence of diverse pastures and regenerative grazing practices versus standard ryegrass/clover pastures and contemporary grazing practices on a wide range of soil, pasture, environment, animal and product quality outcomes.

The soil research program is a key part of this program and undertakes annual measurements of soil biological, chemical and physical properties, as well as nutrient leaching and nitrous oxide emissions. Early results suggest no effect of the pasture types or management on earthworms, ground-dwelling mesofauna or above-ground insects, although the most abundant species of earthworms was higher under diverse pastures and regenerative management in 2023. We have measured trends for more favorable soil physical properties and labile carbon under diverse pastures, but another year of data is needed to confirm these results. Nitrate leaching was lower under diverse pastures and regenerative management and nitrous oxide emissions were lower under diverse pastures, but again, more data are needed to be confident in these results and to understand what might be driving these effects.

SESSION FOUR: Transitioning to a multispecies pasture - opportunities and challenges

Karrinjeet Singh-Mahil & Brian Schuler, dairy farmers

Our farm has a number of different soil types but around one third is clay to silt black flats and the rest is mostly silt to sandy loam on rolling country. The black flats can be difficult to manage in winter whereas the lighter ground is challenged in the summers.

Our rainfall is 750-850mm but there is ever-increasing seasonal variation.

We were finding that the traditional ryegrass/clover short rotation and perennial mixes were increasingly unable to survive the summers, and what did was subject to being pulled out very quickly by the cows at the autumn break, even with delayed grazing, because of its regressed roots. This meant higher costs to resow extensively and additionally, we were seeing erosion between plants as we experience a lot of wind where we are located.

One of the consequences of this was considerable business risk around needing to buy in hay at peak demand times.

During the 2012-13 year, the region was in drought and we were buying in lots of hay, at great expense, to get our herd through. Our debt had ballooned very quickly because of the cost of hay and grain. We had cows with Left Displaced Abomasum and Right Displaced Abomasum, something we'd never had before.

We had a conversation about what we were going to do. Brian was seeing soil scalloped out between the surviving ryegrass plants and Karrinjeet had seen a presentation about the potential impact of climate change on the region's soils. That impact was likely to be on our better soils, the free-draining ones, an impact we were already seeing on the farm.

We knew something had to change and that it had to be the way we farmed. We started by working out what could fix the most urgent problems: the erosion and the lack of persistence in the pastures.

We asked other farmer-friends what they were doing. We asked our seed merchants. We asked Dairy Australia but at the time all the research was focused on ryegrass. We looked at DA's work for the northern dairy regions. We read extensively, considered Brian's experiences in Ecuador and talked to farmers in other countries.

We decided to start with one paddock and to see what worked from there. This was a low-risk strategy and using a low-risk strategy was important given the financial situation the 2012-13 season had put us in.

Not everything we did worked but because we were moving one or two paddocks at a time, we were able to try again and again until we found what worked in each paddock.

Cam Nicholson - Director, Nicon Rural Services

Making the decision to transition to multispecies pastures

Changing your feedbase is not an easy decision. There are many, often competing factors to consider, along with some unknowns as well as your appetite for risk. Knowing what influences your decision and having a process to work through these influences is valuable to increase the chances of making a good decision.

The key concepts of decision making to be discussed include:

1. The difference between a 'good' and a 'right' decision. Skilled decision makers focus on making 'good' decisions and use the 'wisdom of hindsight' to learn, especially when the results don't turn out how we would like.

2. How complex decisions are influenced by our head, our heart and our gut.
   - The head is the logical or orderly approach to analysing and solving a problem.
   - The heart is the emotional influence on the decisions. They are based on our values, beliefs and fears.
   - The gut refers to the intuitive influence on a decision and is shaped by our experiences and knowledge. The way we view, and frame risk largely resides here.

3. Complex decisions are likely to contain both pros and cons and a skilled decision maker will weigh up the 'pros' and 'cons' and make a decision 'on balance'.

4. Including risk, which they do by 'framing the odds' of various outcomes. Knowledge and continuous learning help to refine those odds.

An approach that brings together the head, heart and gut, critical variables and risk will be demonstrated as a practical way of structuring a decision around transitioning to multispecies pastures.

Dr Anna Thompson - Senior Research Scientist, DEECA

The Resilient Forages Project: Designing productive perennial multispecies swards for Victorian dairy farming systems

The Resilient Forages project aims to prepare pastures to be productive, resilient and environmentally beneficial both now and in future climate scenarios.

One aim of the project is to investigate how to precisely design and implement multispecies swards according to a farm's use-case and environment. To this end, a multi-site, multi-year, plot experiment was established in Victoria, Australia, in autumn (April-May) 2023. Four perennial multispecies swards varying in functional group ratios are being compared with a monoculture perennial ryegrass (PRG) control.

The multispecies treatments are grass-heavy, herb-heavy, legume-heavy and even in their functional group ratios but contain the same 12-species (four grasses, four legumes, four herbs). Seed mixtures were altered to create the desired functional group dominance. All treatments are paired with a nitrogen (N) fertiliser rate depending on expected legume proportion (between 0 and 200 kg N/ha/yr).

Treatments are replicated four times within each of three sites: two sites in the high-rainfall Gippsland region at the Ellinbank SmartFarm, and one site in the medium-rainfall South-west region at the Hamilton SmartFarm.

In this talk, results from the establishment year (May 2023 – May 2024) will be presented, including establishment rate, available biomass, biomass nutrient concentrations, and botanical composition. The study findings show that multispecies treatments exceeded the yield of PRG and provided greater late spring, summer and autumn growth at the high rainfall sites. Yields were similar across treatments at the medium rainfall site, but the multispecies treatments required less N input to achieve that yield. Multispecies forages also had favourable nutritive characteristics for dairy production at all sites. This talk will arm first-time adopters with the knowledge required to go away and design their own productive and nutritious perennial multispecies pastures in the future.

Jen Smith - General Manager, Gippsland Agricultural Group & dairy farmer

Persistence, Production, and Profit

Brad and Jen Smith, sheep and cattle farmers from East Gippsland, have spent the past decade transforming over 600 hectares of underperforming pasture into high-yielding, resilient perennial systems. Their property was once dominated by low-performing monocultures of bent and barley grass, alongside solid paddocks of manuka, blackberry, bracken, saffron, and scotch thistle—so dense they could have been baled. Through strategic renovation, they have successfully turned these challenging paddocks into diverse, productive pastures that support their livestock enterprise.

As one of six farms participating in an MLA Producer Demonstration Site (PDS) focused on establishing perennial pastures, the Smiths have refined an approach tailored to their highly variable climate. Their preferred method involves two seasons of annual cropping with a summer fallow, creating optimal nutrient and seed bed conditions for perennial pasture establishment. Their goal is ambitious but achievable: to build a non-irrigated feed base that consistently produces 12 tonnes of dry matter annual per hectare on average.

Their carefully designed multispecies pasture mix includes subcovers to provide critical early-season feed when grasses are slow, Phalaris and cocksfoot for structure, bulk, and persistence, and aerial clovers to maintain feed supply through summer when the sub clovers dry off. This diverse mix has significantly improved soil structure, increased organic matter, and enhanced microbial activity. Importantly, the deep-rooted species utilise rainfall efficiently, minimizing runoff and maximizing soil moisture retention.

The Smiths' commitment to improving their pastures is not just about short-term gains—it is about long-term resilience, productivity, and profitability. Their approach demonstrates how targeted pasture management can overcome environmental challenges, enhance livestock performance, and contribute to a more profitable agricultural system. Their work is setting a benchmark for pasture renovation in dryland grazing systems, offering valuable insights for other producers facing similar challenges.

SESSION FIVE - Designing a pasture and forage mix for your region

Dr John Finn - Teagasc, Ireland

The design of multi-species mixtures for more outputs from less inputs

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Multi-species mixtures can vary in several ways, which complicates experimental approaches to understanding the effects of varying the type of species, the number of species, and the relative proportions of the species. We describe our scientific approach that disentangles these multiple aspects of mixtures.

Our research on perennial forage grasslands for temperate regions has focussed on mixtures with up to six species, comprising grasses, legumes and herbs. Most of these experiments are from plot experiments that are regularly harvested by cutting, to simulate grazing. Compared to either a high-nitrogen grass monoculture or the best-performing monoculture, clover-based mixtures with a balanced combination of up to six species deliver the same or higher yields. We also show mixture benefits for weed suppression, nitrogen yield, yield stability, drought resilience, soil biodiversity and nitrous oxide emissions intensity.

How do multispecies mixtures perform as part of livestock systems? Six-species mixtures of grasses, legumes and herbs with lower nitrogen typically perform the same or better than either a two-species grass-clover combination with lower nitrogen, or a grass monoculture with higher nitrogen.

One key issue for future research is to better assess the relative benefits of multi-species mixtures in relation to two-species grass-clover swards. In the face of high economic and environmental costs of inorganic nitrogen fertiliser, the contribution of symbiotic N_2 fixation by legumes to grassland N supply will only grow in importance as a key strategy to maintain levels of production and protein self-sufficiency in a more sustainable way. Another key issue is that even if mixtures perform no better than grass-clover, there is a need to better investigate whether they deliver higher levels of other ecosystem services (e.g. drought resilience, lower greenhouse gas emissions, soil health, carbon sequestration and water quality).

Damien Adcock - Barenbrug Australia, Dandenong South, Victoria

Which Species? Where and Why: Grasses, Legumes & Herbs.

Productive temperate pastures, such as those used to underpin the dairy feedbase, have traditionally consisted of low species diversity coupled with high management intensity and associated fertiliser inputs, in particular nitrogen. Increasing species diversity can provide high yields of forage for livestock production with lower environmental impacts (Finn *et al*. 2024).

Numerous studies have demonstrated the importance of diversity for proper functioning of soils, plants, and ruminants. For example, Baker *et al*. (2023), demonstrated the potential for higher dry matter production of a six species sward from lower nitrogen inputs relative to a perennial ryegrass monoculture or a ryegrass-white clover mixture. A review by Distel *et al*. (2020), also highlighted the importance of diverse forages from both a plant and phyto-chemical perspective, for animal health, welfare, and nutrition, in addition to providing ecological functions.

Greater species diversity affects soil physical, chemical, and biological properties both directly and indirectly from enhanced biomass activity, and directly through the supply of organic matter and root exudates to soil biota (Coleman *et al*. 2017; Zak *et al*. 2003). More importantly, plant species differ in below ground structure and function, which also influences soil biota and soil function (McNally *et al*. 2015). The mechanisms for the positive relationship between species diversity and productivity are due to differentiation in resource use both spatially and temporally.

However, Thomson and Albornoz (2023) have remarked that species richness alone does not guarantee productivity and that the choice of species or proportion of each functional group (i.e. grasses, legumes, and herbs/forbs) is crucial for success. As Sanderson *et al*. (2007) states, "*pasture diversity is not simply a numbers game of mixing and sowing as many species as possible*". The type and amount of different pasture species are key variables that need to be considered when designing a diverse multi-functioning pasture sward.

Adequate species selection for a diverse pasture sward represents a challenge. Initially diverse pasture communities tend to become dominated by a few species over time. Botanical composition changes with time. So how do we ensure a diverse pasture base that is both productive and persistent when confronted with biotic and abiotic stresses?

Can we redesign the dairy feed base with the current range of the grasses, legumes, and forbs available? Or do we need to consider, or rediscover, species from a wider array of forage options, to create feedbase that is productive, persistent, profitable, and environmentally beneficial?

Elena Minnee - Senior Scientist, DairyNZ, Hamilton, New Zealand.

Plantain (*Plantago lanceolata*) benefits beyond forage production.

Traditionally, sown pastures in New Zealand have comprised perennial ryegrass (*Lolium perenne* L.) with white clover (*Trifolium repens* L.). These pastures support high livestock production but frequently contain nitrogen (N) concentrations that exceed animal requirements, resulting in excess dietary N excreted in dung and urine. Nitrogen excreted in urine onto the paddock is at risk of leaching into groundwater and loss to the atmosphere, contributing to environmental pollution.

Renewed interest in providing diverse pastures for grazing dairy cows to improve pasture quality and overcome summer-autumn feed deficits has led breeders and researchers to explore alternative species. Through this exploration, plantain (*Plantago lanceolata* L.)-based pastures have emerged as a productive pasture mix that can improve animal performance and potentially mitigate the environmental impact of pastoral farming.

Including plantain in the diet of dairy cows can improve feed intake and milk production with little impact on milk quality. The mechanisms through which plantain can reduce the risk of N loss include: (1) dilution of urinary N through increased urine volume, expressed in more frequent urination events; (2) greater partitioning of dietary N to milk and faeces, and less to urine; (3) a nitrification-inhibiting effect from urine of livestock fed diets containing plantain; and (4) a nitrification-inhibiting effect from plant material and soil exudates. Paddock-scale measurements of N leaching reductions from pastures including plantain range from 17-42%, depending on the proportion of plantain in the sward relative to grass/clover pastures. Cumulative nitrous oxide emissions are reported to be reduced as the proportion of plantain in the diet and in the sward increases. Furthermore, emerging research suggests that when plantain substitutes part of a grass/clover diet in autumn, enteric methane emissions are reduced relative to cows not fed plantain. Combined, these results suggest that including plantain in pastures on dairy farms can enhance the productivity and sustainability of the system.

Adam Forbes - Dairy farmer, Gloucester

Adam Forbes is a fourth-generation dairy farmer based at Gloucester on the mid-north coast of New South Wales. Along with his parents, he operates a pasture-based system on the Barrington River, milking around 750 cows throughout the year. The farm faces diverse climatic challenges, including hot, humid summers and unpredictable wet or dry conditions, which demand continual adaptation to maintain a high-quality fresh milk supply.

Historically, the farm incorporated some clover, chicory, and prairie grass into its pasture mixes, but difficulties with persistence necessitated more frequent cropping than was ideal. Approximately 15 years ago, the operation embarked on a transition by establishing a mixed species pasture on a dryland heifer run. This initiative replaced sections of Rhodes grass and natural pastures with soft cocksfoot, chicory and clover, which creating enhanced dairy heifer country. The new system provided higher ME and lower NDF compared to traditional pastures, enabling these areas to raise heifers, and the previous heifer raising areas to join the milking platform.

To combat summer heat stress, the farm aimed to develop a highly utilisable and top-quality summer pasture. This process began through the use of summer crops and winter cereals aimed at reducing the weed seed bank. Following this a spring sowing of lucerne and chicory was undertaken. and this has remained a consistent strategy through the process and really ticked the boxes regarding a summer pasture option. The next step involved introducing grasses to the system, but initial experiments with annual and Italian ryegrass proved unsatisfactory due to their dominance and subsequent seasonal gaps. Further trials incorporating cocksfoot and prairie grass resulted in improved ground cover, feed quality and persistence across the season.

Nutrient management, particularly regarding soil potassium, remains a key focus. Slow-release potassium amendments and organic applications such as chicken litter, compost and cow manure have enhanced soil fertility and organic matter. Moreover, the deep-rooting characteristics of cocksfoot, lucerne, and chicory have allowed for more flexible irrigation practices under challenging conditions. This holistic approach to milk production highlights the farm's commitment to sustainable and innovative dairy practices.

Jade Killoran - Healthy Farming Systems

Multispecies pasture mixes commonly contain species from three main plant functional groups; grasses, legumes and non-leguminous broadleaves such as herbs and brassicas.

Projects conducted throughout southern Victoria have identified that multispecies pastures can produce high quality fodder and reduce feed gaps experienced in perennial ryegrass systems. Furthermore, they can reduce inputs such as fertiliser and conserved fodder, and improve groundcover, soil structure, soil biological activity and drought resilience.

To ensure the adoption of multispecies pastures is successful, the establishment strategy must be effective. First, it is vital to control existing plant competition before sowing the multispecies. The strategic use of herbicides or cultivation equipment will prevent establishment failures. The level of chemical control or cultivation required will be specific to each individual paddock scenario and should be reduced over time as circumstances allow.

If herbicides are used, this can ensure that there is no competition and can avoid cultivation where it may cause damage (eg. on lighter soils or slopes).

If cultivation is used, the goal should be to achieve successful establishment with minimum soil damage. This involves selecting a machine that provides appropriate seed bed preparation and competition control, while performing the least level of cultivation deemed appropriate for the paddock. The selection of machinery will vary depending on soil type, existing pasture, time of sowing and other factors.

Secondly, a good strategy for transitioning from a conventional to a multispecies pasture system is to use annual multispecies mixes in the initial establishment phase. Annuals are cost effective, rapidly establishing species which can be used strategically to 'prime' the system by improving weed control, soil biological activity, nutrient cycling, soil structure and other parameters. Using annual multispecies strategically can ensure that the transition from conventional pastures to multispecies pastures is low risk, rapid and successful.

Once the system is functioning, which may require several annual multispecies sowings, a change to perennial species can be achieved. These perennial multispecies mixes can also be 'topped up' with annual or perennial species periodically to maintain production and diversity. Depending on soil type, topography, feed gaps and production goals, varied multispecies mixes could be sown on-farm, comprising a mosaic of diverse pastures across the landscape to ensure the farm performs to its economic and environmental optimum.

SESSION SIX - Incremental strategies to achieve better soil health - steps in the right direction

Gillian O'Sullivan - Irish Dairy Farmer

Incremental Soil Health Improvements

Soil health is the foundation of sustainable and productive farming systems. However, improving soil function requires an integrated approach, addressing soil physics, chemistry, and biology in tandem. This presentation focusses on how incremental soil health improvements—tailored to specific farm conditions—can drive long-term resilience, productivity, and environmental sustainability.

A detailed assessment of our farm's soils revealed key strengths and vulnerabilities. While free-draining soils support extended grazing and exhibit strong biological activity, challenges include shallow soil profiles, drought susceptibility, and nitrate leaching risks. Using soil pits, slake tests, GrassVESS scoring, earthworm counts and nutrient analysis, we identified areas requiring intervention.

Physical improvements focus on alleviating compaction and enhancing rooting depth. Multispecies swards (MSS) with deep-rooting species such as chicory and plantain to improve drought resilience and soil structure. Min till adoption further protects aggregate stability and reduces risk of soil erosion.

Chemical assessments point towards macro nutrient availability. Strategic liming maintains soil pH around 6.5, enhancing nutrient uptake, clover establishment and microbial activity. Targeted applications of nutrients support pasture productivity, particularly for clover establishment.

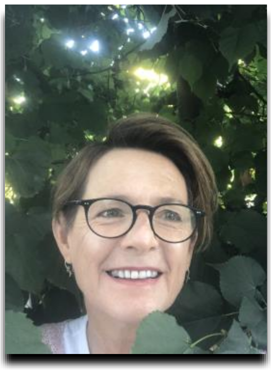
Biological activity boosts soil function. Increasing organic matter through strategic manure/compost application and grazing management stimulates microbial activity, while monitoring earthworm populations provides a key indicator of soil health.

By implementing the right measures, at the right time, in the right location, we aim to create a system that builds soil health incrementally. This approach ensures improvements are measurable and monitored, supporting long-term farm productivity while mitigating risks of soil degradation.

Dr Pauline Mele - Molecular biologist, Biome Services

The soil 'biological bridge' to better dairying

There are four key considerations.



1. **Keep your eyes on the prize**
   - A better-quality product (e.g. nutrient dense milk)
   - Reduced synthetic inputs
   - A healthy enterprise
   - To comply with sustainability guidelines; companies are increasingly expected to report against ESG goals

2. **Understand the basics**
   - Soil biodiversity can be defined as the number of different types or species or varieties of living things, in this case microbes (bacteria, archaea & fungi); there are no set targets but always assumed 'the more the better'

- Soil biodiversity can also be defined as the number of different functions including,
  - Nitrogen fixation (symbiotic & free-living)
  - Phosphorus release
  - Carbon decomposition
  - Disease control/suppression
  - Plant growth promotion (hormones)
- Different soils have different biodiversity (down a profile, across a paddock); must capture this variability in sampling routines
- Most microbes need oxygen *but* are highly adaptable to changing oxygen levels that occur continuously during wetting and drying cycles
- Most microbes operate best within pH_{wa} 5.5-7.5

3. What actions can I choose? (to harness the soil biodiversity)

- Describe the starting point/condition of soil (biology, structure, chemistry); soil health guides are useful and monitor the change
- Examine the food supply, pasture composition! Is there variety? >introduce one to two pasture types to current mix (Grasses, Legumes, Brassicas, Forbes)
- Is the soil surface exposed? Keep always covered; Consider timing of pasture transitioning/renovation (winter annuals/summer annuals); grazing regimes
- Consider seed coats and fertilisers; Am I blocking beneficial microbes from doing their thing?
- Consider biological alternatives (there are many); will they work on my farm?

4. How am I tracking?

- Sensory: Look (take a photo, smell, feel)
- Quick & generic field tests: Solvita®; ***microBIOMETER***®, cotton strips/undies etc
- Commercial tests (few): Select, Sample & Send-off & Receive interpretation (act or not)
- Testing requires that sampling covers the paddock variation (and mix of soil types)
- Useful **surrogates:** what other tests will tell me about soil microbes? pH? Organic matter, pasture type?

Take home message

Building the soil biological bridge requires multiple actions and time (months & years!). Despite the significant growth in knowledge of soil microbiology, all actions must operate within the soil types on our farms. Alternative products can offer a way forward but without protections afforded by regulation, farmers are operating in a 'buyer beware' market.

Biome Services
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Angela Avery, Research Director Agriculture Resources Sciences, Department of Energy, Environment & Climate Action (DEECA)

Dairy Soils – research that assists to build the pieces for change

Dairy Soils is a part of DairyFeedbase, a partnership between Dairy Australia, the Gardiner Dairy Foundation, and Agriculture Victoria. Dairy Soils uses cutting-edge technology and bioscience to help improve profits for farmers. Imagine if you could measure, monitor and manage the nutrient status and nutrient cycling in your soils, regardless of the source of those nutrients.

To enable you to do this, Dairy Soils is investigating three main questions:

1. Can we improve how we use fertilizer and boost pasture production by better measuring and managing soil differences within the paddock and throughout the soil profile?

2. Can we improve how the rhizosphere works by promoting deeper roots and healthier microbial populations to make water and nutrients more available for pastures?
3. Can we reduce the use of synthetic fertiliser for efficiency and sustainability by greater use of soil microbes and home-generated fertiliser from manure and effluent?

The Dairy Soils project started in July 2024 at the Ellinbank SmartFarm. I will share what we have learned so far, including the knowledge and practices that guide our research. I will also explain how you can get involved in this five-year project.

Overview Dairy Soils

Kate Mirams & Peter Neaves - Gippsland dairy farmers

Wins, losses and learnings

What are we ultimately trying to create, and how did we get from where we were to where we are now? Did we crash the system? What did we learn along the way?

We set out to build a strong symbiotic relationship between the plants and the soil microorganisms.

What is the benefit?

Soil microorganisms have a huge range of roles in building the physical and chemical fertility. From a physical perspective they help aggregate the soil, allowing more air in, and increasing water infiltration, and make the soil easier for roots to penetrate more deeply. From a chemical perspective microorganisms are able to access a tightly held minerals such as phosphorus that plants can't access, fix Nitrogen, hold onto nutrients in the soil reducing leaching. Additionally, they create a whole range of signaling chemicals that stimulate root growth, plant growth, enhance disease resistance, and enable plants to have higher nutrient density, higher phenols and other beneficial components.

With good plant microbe symbiosis, we grow pasture that is lower in nitrates and higher brix (sugars), and higher in the full range of proteins and minerals; better for cows and ultimately better for human health.

If plants don't feed the microorganisms, the microorganisms struggle to feed the plants.

Thriving soil biology is critically dependent on building this symbiotic relationship between the plant and the soil microorganisms. Through photosynthesis plants create sugars and build them into carbohydrates, protein, and a whole range of complex signaling compounds. Plants are able to exude a portion of these nutrients out through their roots into the soil to feed the biology.

How do we set up plants to feed the soil microbiology, so the soil microbiology can feed the plants?

How have we done this without crashing pasture production and milk flow?

First there are a whole lot of practices that soil microbiology don't like, that we discontinued, minimized and are find a way around.

Then there are a whole range of practices that create a good environment for soil biology that we have begun to put into practice.

We will share our transition journey, including the crashes and our learnings, to get where we are now.