DairyBio

Achievements Report

2021

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Introduction

Dairy Australia is a long-term investor in bioscience because it is a big driver of profit and productivity on farm. The changes that can be made through genetics and breeding that lift the quality of pastures and herds is of great value. This achievement report sets out a broad range of improvements that will be highly desirable for dairy farmers, will generate permanent gains on farm, and will set up future productivity growth for decades to come.

DairyBio has demonstrated again the merit of investing in both plant and animal bioscience in a side-by-side manner. There have been numerous cross-over benefits, especially taking a proven technology like genomics in animal breeding and translating this to pasture breeding.

Sustained investment in bioscience is also allowing research teams to broaden their focus and to deliver benefits such as new traits, to speed up the breeding process further, and to cope with an ever-growing scale of data used to estimate the merit of animals and plants.

As a result of this investment, we also know a lot more about the genetic makeup of plants and animals, focusing on genes that have critical impacts on traits like fertility and health, and identifying more efficient ways to breed improvements, such as more effective varieties of hybrid ryegrasses.

I commend this achievement report to all dairy farmers, to all our partner investors, and in particular to governments, who have been major investors in enabling world-class science for Australia.

David Nation Dairy Australia, Managing Director

Creating farming's future with bioscience

DairyBio – an overview

Improving pasture and animal productivity for a sustainable and profitable dairy industry

It's hard to imagine a more perfect pairing that agriculture and bioscience.

Both have an insatiable appetite for knowledge.

And both understand that knowledge not only delivers power, but it also provides options.

For Australian dairy farmers, DairyBio is tasked with the job of improving pasture and animal productivity and reducing costs, all while helping the industry meet evolving societal expectations and adapt to the changing climate.

DairyBio delivers the research, analysis, and science behind world-leading innovations.

It then teams with commercial partners to help push this new technology and practices out to where it will make the biggest difference – on Australian dairy farms.

DairyBio is the dairy industry's leading bioscience research program.

A joint venture between Dairy Australia, Agriculture Victoria, and the Gardiner Foundation, its overarching target includes improving pasture productivity by $800 a hectare and animal productivity by $350 a cow by 2030.

And according to recent independent analysis – it's well on its way to meeting those goals.

Consultants Marsden Jacob Associates (MJA) found DairyBio delivered products that provide an average benefit-cost ratio of 18:1.

The net financial benefits provided by DairyBio, uncovered by MJA – such as improved pasture, animal selection and management – exceeded expected returns from other Research, Development and Extension investments.

Included in this figure were projects and programs many Australian dairy farmers are not only benefiting from on-farm, but they've also contributed vital data to make it happen.

DAIRYBIO'S INNOVATION PIPELINE

- New genomic and F1 hybrid pastures in the commercial release pipeline
- The Sustainability Index – breeding animals for lower greenhouse gas emissions
- More next-generation animal breeding values
- Fertility breeding value enhancement

Data-driven decisions

DairyBio collects and analysis genotypic and phenotypic data that strengthens the Australian breeding values (ABVs) which underpin the nation's three dairy breeding indices Balanced Performance Index (BPI), Health Weighted Index (HWI) and Sustainability Index (SI).

This same information – often with the assistance of new sensor technologies or milk mid-infrared data – also helps identify traits for new breeding values.

For example, the world first Heat Tolerance ABV, the efficiency-generating feed saved ABV or the cost-saving and animal welfare-enhancing mastitis resistance ABV.

All this work has contributed to genetic gain of more than 50 per cent for farmers and the entire industry.

In addition, DNA based targeted cow management tools – such as genomics – have delivered a return of more than $80 a cow, while selecting to breed for health traits can cut health costs by 10 per cent.

These savings and productivity bonuses add-up.

They also make business more sustainable and agile, able to adapt to changes in public policy or climate.

When it comes to pastures, thanks to research conducted by DairyBio, the world's first gene edited ryegrass plants are growing and being tested. These plants will be crossed to yield better quality pastures, delivering dairy farmers more bang, for their forage-buck.

Huge progress has also been made in pasture breeding, with scientists in the DairyBio forage program delivering 21 years of forage genetic gain in just seven.

Highlights of this project include a 20 per cent boost to ryegrass yield through hybrid technology being commercialised and the addition of three extra productive years to ryegrass pastures.

Fostering careers

Research within the DairyBio animal and forage programs is ongoing.

The organisation works hard to attract the best researchers to the Australian dairy industry, through its PhD program, and then supports them through mentor programs and industry engagement to encourage them to stay.

After all, having the best bioscience researchers, working with quality data and cutting-edge technology, is the best way to power Australian dairy.

DairyBio in numbers

18:1
benefit-cost ratio

50% ⇧
genetic gain
animals

10 ⇩
lower health costs
animals

+3
years longer
productive life
pastures

20% ⇧
yield increase
ryegrass – pastures

Five ways DairyBio is delivering for dairy

Big picture science

1 Adapting to a changing climate

The heat tolerance Australian breeding value

Dairy farmers can now identify and breed for animals with a greater ability to tolerate hot and humid conditions with less effect on milk production.

The world-first breeding value was created by the DairyBio team using advances in genomic technology to identify the genetic markers associated with heat tolerance.

Combined with other on-farm tools such as shade and shelter, breeding can help farmers deal with the challenge of changing weather patterns.

Reducing emissions

Breeding is now a tool to help dairy farmers reduce their business' greenhouse gas emissions.

Thanks to DataGene's Sustainability Index, backed by DairyBio research and analysis, it's possible to reduce the amount of carbon emitted by a dairy herd, relative to its milk production.

With a focus on longevity, feed efficiency and production, breeding a greener cow doesn't mean farmers sacrifice vital profitability traits either.

2 Breeding healthier animals

Next generation Australian breeding values

Mastitis resistance

Dairy farmers can now directly breed for improved mastitis resistance.

Creating the Australian breeding values (ABV), researchers from DairyBio drew on vital on-farm data and animal trait information including the 305–day somatic cell count, udder depth and clinical mastitis records.

Previously, farmers used the cell count ABV to indirectly select for mastitis resistance.

Reducing mastitis in dairy herds improves animal welfare, increases productivity, and reduces costs. It also increases milk quality which could have financial benefits.

Gestation length

A shorter gestation means cows calve earlier and are in milk for more days before re-joining. Having more time to recover after calving improves fertility and a cow's overall health and welfare.

The gestation length ABV allows farmers to identify bulls with a shorter gestation length to breed to cows at the end of a mating period.

3 Genomic calving ease

An easy calving is good for cows, calves, and farmers. Breeding a cow or heifer to a bull whose progeny are born more easily than the average is a way to improve health and animal welfare.

DairyBio's more recent genomic analysis has also enabled genotyped Holstein cows to have a calving ease ABV. This means dairy farmers have a clear understanding of a cow's calving ease ABV and can orchestrate her mating to maximise calving ease.

The Health Weighted Index

A breeding index for farmers wanting to fast-track genetic gain for traits such as fertility, mastitis resistance and feed saved.

The Health Weighted Index is underpinned by DairyBio genotypic and phenotypic data collection and analysis and provides farmers with accurate guidance to select animals that meet their breeding objective.

4 Boosting productivity

Improving pasture persistence and yield with novel endophytes

DairyBio's forage program has uncovered new – or novel – endophytes that can increase the persistence of dairy pastures by up to three years.

These endophytes also improve the pastures' ability to withstand pests and disease, particularly in its early establishment.

This work will not only contribute to the fastest-ever genetic improvement in pastures and endophytes, but it will also save dairy farmers time and money with less need for pasture renovation.

These novel endophytes have been bred into new ryegrass varieties with DairyBio delivering this technology into the commercial market for distribution.

Gene editing pasture

Targeted gene editing can deliver new and positive traits into existing ryegrass and warm season grass varieties to improve persistence and forage quality.

Enhancing the persistence of vital forage sources can help farmers produce more homegrown feed and potentially bolster fodder storages. Both are vital in the event of extreme weather or drought.

5 Profit driven

Feed Saved Australian breeding value

A cow that produces the same amount of milk with less feed requirements is not only a dairy farmer's dream bovine, but it also makes financial and environmental sense.

And thanks to DairyBio feed efficiency research – measuring and monitoring feed intake and milk production – dairy farmers can now breed cows that save on feed.

Increasing forage yields with hybrids

Thanks to genomic technology a new hybrid – or crossbreeding – technology is delivering dry matter yield increases of 20 per cent for ryegrass.

Increasing the productivity of ryegrass improves the efficiency and sustainability of dairy businesses by getting more from existing pastures.

DairyBio has partnered with commercial business to deliver this hybrid technology to the market and into the paddocks of the nation's dairy farmers.

6 Future focus

Fertility prediction through milk mid-infrared data

A milk sample taken for a routine herd test on a dairy farm can now reliably predict the fertility of high and low fertility cows.

Further trials are scheduled with DairyBio's commercial partner DataGene, but this technology has the potential to help farmers make more informed herd and farm management decisions.

For example, targeting sexed semen usage.

Human health concentration

Genomic technology opens the door to genetically select dairy cows to produce 'niche' milk to improve human health.

One opportunity is to breed cows to produce human milk oligosaccharides, a component that provides some benefits of human breast milk.

7463

Driving efficiency with animal genetics

Animal program

Breeding better dairy cows for a more profitable industry

DairyBio is proof it's possible to conduct world-leading research while also delivering value back to the farmgate.

On track to generate gains of $350 a cow per year by 2030, DairyBio's animal program uses genetics and the latest technologies to increase dairy farm productivity and lower cost.

Underpinned by scientific breeding, the DairyBio animal program adds value to the dairy industry through genetic improvement.

Bolstering the dairy industry's genomic reference population, DairyBio increased the reliability of ABVs.

This, alone, has led to an improvement in genetic gain of 50 per cent, by enabling farmers and their breeding advisers to select – with confidence – younger bulls for their Herd Improvement program.

Other key achievements include advances in reversing the industry's fertility decline and enhancing fertility prediction with milk mid-infrared.

Developing a feed saved ABV to reduce on-farm costs and improve efficiencies has also been a highlight.

DairyBio has found a dairy farmer concentrating on breeding for the health traits it discovered could cut their health costs by 10 per cent.

But breeding for health isn't just about reducing expenses.

The newly developed mastitis resistance ABV, genomic calving ease ABV and gestation length ABV contribute to better animal welfare outcomes.

Delivering 'world-first' technology to the Australian dairy industry, DairyBio has used genetics to create solutions for on-farm challenges such as Heat Tolerance.

Thanks to the work of DairyBio, Australian farmers can now breed cows that are more tolerant to hot and humid conditions. This work has been embraced globally with DairyBio and the Australian dairy industry recognised as global leaders.

Animal program achievements

- Developed a feed efficiency Australian breeding value – feed saved ABV
- Created the world's first heat tolerance breeding value
- 10 per cent reduction in health costs by breeding with selected health traits
- Delivered value of more than $80 per cow through DNA-based cow management tools
- 50 per cent genetic gain
- Reversed declining fertility rates
- Facilitated a three-fold increase in genetic gain
- Improved the reliability of existing ABVs
- Introduce ABVs for traits such as genomic calving ease and gestation length
- Combined clinical disease records, somatic cell count and udder depth for a mastitis resistance ABV
- Proven milk mid-infrared technology can reliably predict high and low fertility for individual cows
- Crossbred ABV progression

Animal program snapshots

Project 1

What Accelerating genetic gain in dairy cattle

Why To increase genetic gain in the dairy industry by an additional 50 per cent for traits that contribute to profit and generate information that underpins all animal improvement projects.

How Use improved SNP-chip technology for ongoing genotyping, continue to add to the industry dataset that began with the 1000 Bull Genomes project and further cross-bred genomic selection for cows and bulls.

Details The overarching DairyBio animal program project, it underpins all animal improvement research. Huge datasets of genomic information provide the reference for validating animal traits and improving the reliability of Australian Breeding Values. Introducing genomic technology into cross-bred herds is set to further increase the dataset and boost genetic gain within this sector of the industry. Future work includes conducting 'run eight' of the 1000 Bull Genome project, which will include 5500 cattle. A plan to evaluate implementing prioritised SNP and new variants in a multi-breed genomic evaluation, with DataGene, has also been earmarked.

Project 2

What Supporting the implementation of key innovations, maintaining, and improving existing services, while reducing the cost and improving access to cow genotyping.

Why To enable dairy farmers to breed for traits such as genomic calving ease and gestation length. Improve existing ABVs and introduce genomic prediction for production and cell count ABVs in red breeds.

How Continue to expand the quantity and quality of the cattle reference population. Investigate emerging trends.

Details This project will continue to improve existing work such as updating the feed saved ABV using feed efficiency data from Australia, North America, and Europe. Improvements will also be made to the genomic prediction of fertility with the addition of intermediate phenotypes such as milk mid-infrared (MIR) data. Inbreeding trends, since the introduction of genomic technology, will also be investigated.

Project 3

What Developing breeding values for new functional traits, particularly those associated with health and resilience

Why To lower health and reduce the labour costs associated with dairy cow health.

How Utilise Australian and global genomic data to bolster the dairy cattle reference population. Use genomic predictions for indications of early lactation disease. Investigate the finding that some serum metabolite, that are indicative of early lactation disease, are heritable.

Details New health traits are anticipated to contribute to a genetic gain of up to 5 per cent which will improve dairy farmer profit. This project has contributed individual cow feed efficiency and methane data to an international repository. Collaboration with the USA, Canada and several European countries continues to evaluate the accuracy of genomic prediction of methane emissions phenotypes. Investigation continues into options for reducing greenhouse gases using genetic selection.

Project 4

What Study the phenotyping of complex traits in dairy cattle

Why To provide oversight of existing projects such as Improving Herds and MIR for Profit. Plan future activities.

How Assess phenotypes and analysis of high and low fertility cows determined by milk mid-infrared (MIR).

Details Key achievements for this program include uncovering a milk mid-infrared (MIR) prediction of probability of conception in high and low fertility cows and prediction of metabolites indicative of early lactation disease. Lameness scores were also collected at the same time as herd-testing and MIR prediction of these scores to determine if MIR can predict lameness.

Project 5

What Build on the research about the value of joint reference populations for core traits

Why Enhance existing research on cross-bred genomics

How Working with genetics company CRV, the project will investigate methods for cross-bred genomic prediction.

Details CRV shares its New Zealand and Australian reference population with DairyBio to bolster the number of cross-bred genotypes available for research. The shared reference population includes 52,000 CRV-NZ cows and 78,000 Australian cows. DairyBio's work will support the implementation of cross-bred genomic predictions using a multi-breed reference population.

Project 6

What Improved prediction of the daughter fertility breeding values

Why Develop a biologically more precise genomic breeding value for fertility. Improve breeding outcomes for Australian dairy farmers.

How Extensive use of milk MIR defined predictor traits, advanced phenotyping – using sensor technology – and genes identified to explain some of the genetic variation in fertility.

Details This project will develop and deliver the next generation of fertility ABVs. Priorities include genomic analysis of high and low genetic lines for fertility and to evaluate if MIR can enhance the prediction accuracy of fertility ABVs.

Youtube

Hear from Professor Jennie Pryce, lead scientist on the DairyBio animal program, about the latest research that will transform how Australian dairy farmers manage and breed their cattle.

Accelerating pasture genetic gain

Forage feature

Improving Australian dairy's feed base

Gene editing will enable Australia's dairy industry to improve its elite varieties of ryegrass, warm season grasses and lucerne.

Taking the best and breeding them better, DairyBio's genome editing projects enables the rapid introduction of beneficial traits – such as improved digestibility – while speeding-up forage genetic gain and improving its performance.

Gene editing will create opportunities for new breeding methods that will rapidly introduce new traits into existing elite industry relevant germplasm.

And best of all – the world's first gene edited ryegrass plants are growing and being crossed into elite germplasm.

Genomic selection

Genomic sequencing of forages has provided vital insight into the future performance of plants and this information has also underpinned other genetic advances in pastures such as crossbreeding and genomic selection.

Like the genomic technology used in animal breeding – which is also completed by DairyBio – the DNA of forages is mapped to develop a better understanding of the plants and how they can be improved.

This technology and genomic selection have progressed from the laboratories of DairyBio into commercial breeding operations, delivering the genetic gain dairy farmers want to drive farm profitability.

Genomic selection in ryegrass alone, is delivering an improvement in genetic gain equivalent to three-to-five times the existing genetic progress.

This means the performance of ryegrass on-farm will improve faster, delivering significant yield and persistence enhancements.

Proving this technology works in a commercial breeding program provided the ultimate green-light for its pending rollout throughout industry.

Local researchers drive international genetic library project

Global collaboration

Collecting the DNA sequence of nearly 4,000 bulls boosts genetic gain for dairy and beef industries.

Australia geneticists led an international project to collect, analyse and process whole genome DNA sequences from almost 4,000 bulls.

This data created an international library of cattle genetics which is used to verify animal performance traits and underpin the accuracy of ABVs.

Called the 1000 Bull Genomes project, and lead by DairyBio, the library contains genome sequences of key ancestor sires – the forefathers of today's herds – across most dairy and some beef breeds.

Of the 3,817 bulls included in the cattle genetics library, about half are dairy bulls.

The 1000 Bull Genomes project also aims to identify as many genetic markers as possible by comparing the complete genomes of bulls in the library.

Genetic markers are the variations in DNA that influence animal performance – both good and bad.

They aren't influenced by environment and may occur in several breeds, that's why this data is relevant for dairy and beef herds across the globe.

This library of information also helps scientists fill gaps in DNA sequencing to provide a fuller and more accurate picture of modern genetics to bolster genetic advancement.

Practically, this work enables researchers to compare the DNA of young bulls with the complete genomes of the key ancestor bulls to develop more accurate ABVs.

It has also contributed to Australia's development of the world-first heat tolerance ABV and the feed saved ABV.

A supercomputer in Australia – taking three days to analyse data that would take three years on desktop – has been central to this collection and processing of this information.

Cooperation is key

More than 40 international partners collaborated for this project with all data processed and analysed by Australian researchers.

Proof of the trust and respect Australian researchers and the DairyBio team have garnered throughout the globe, this international spotlight has also delivered many lasting and varied benefits to Australian dairy and science.

For example, attracting top research talent – such as PhD students – to Australia and facilitating further global collaborations with leading cattle genetics researchers.

All this delivers better research outcomes for the Australian cattle industries.

WHAT DOES THIS MEAN ON-FARM?

- Better Australian Breeding Values
- Development of new and improved breeding traits.
- Faster genetic gain
- Attracting and retaining the best international researchers to work in Australia's cattle industries
- Fostering global scientific partnerships to ensure the best information is delivered to Australian farmers

Unlocking productivity and profitability with genetics

Animal feature

Breeding the best animals for local conditions

DairyBio is on-track to deliver $350 more value per cow to Australia's dairy industry, thanks to genetic improvement.

Advances in dairy genetics have provided Australian breeders with the tools to breed for specific health and production traits such as heat tolerance, fertility, feed saved and much more.

These traits contribute to increased profitability by improving yield and decreasing costs —through better health, increased feed efficiency, longevity, and enhanced fertility.

Practically, this means dairy cows that convert feed more efficiency, waste less, aren't as susceptible to disease, are easy to breed and produce profitable volumes of milk solids.

ABVs are assigned to individual traits and are an estimate of the genetic merit of dairy cows and bulls.

For example, an ABV for protein is an estimate of the animal's ability to produce kilograms of protein in milk.

These ABVs tell a story about the potential of each animal based on genotypic and phenotypic data.

But farmers consider multiple traits when breeding.

That's why the dairy industry, through independent organisation DataGene, introduced three indices to rank animals – according to their ABVs – to best match the breeding objectives of Australian farmers and their advisers.

These indices are the Balanced Performance Index (BPI), Health Weighted Index (HWI) and Sustainability Index (SI).

The BPI includes ABVs for traits that influence a cow's performance including production, fertility, functional type, survival, cell count, workability, and fertility.

HWI has a heavier weighting towards health-related traits, while SI is designed to reduce emissions intensity.

DataGene's Good Bulls Guide uses DairyBio's new and improved ways to calculate ABVs to rank bulls available in Australia, enabling dairy farmers and their advisers to choose bulls from the BPI, HWI or SI with confidence.

The reliability of Australian Breeding Values averaged 78 per cent in 2019, up from 44 per cent in 2009.

Reliability of the Fertility ABV was 18 per cent in 2009 and improved to 56 per cent in 2019, contributing to reversing the Australian industry's fertility decline.

After a decade of selecting bulls using the Good Bulls Guide BPI – incorporating DairyBio's ABVs – a herd's milk composition should have 4.1 per cent more fat and 4.5 per cent more protein.

Cows within the top 25 per cent BPI also deliver an additional $300 margin over feed costs per cow.

DairyBio's work has also enabled the development of new ABVs, such as the world-first heat tolerance ABV as well as a mastitis resistance ABV and feed saved ABV.

Continually developing reliable ABVs enables dairy farmers to use breeding as a tool to respond to environmental and climate challenges as well as evolving societal expectations about animal welfare.

WHAT DOES THIS MEAN ON-FARM?

Breed animals that best suit individual farm businesses

- Improve business margins with lowered costs and improved yield
- Benefit from faster genetic gain
- Breeding is a tool to help farmers address climate change, environment, and animal welfare challenges

Improving the performance of pasture

Profitable forages

Developing dairy's future forages

Boosting the rate of genetic gain, improving energy density, increasing yields and delivering longer-lasting pastures.

If dairy farmers had a forage wish-list, DairyBio's research would have ticked every single box.

Tasked with developing dairy pastures for the future, DairyBio's forage program is driven by the need to improve pasture yield, persistence, and quality.

These aspects underpin dairy farm profitability and farm business sustainability.

An independent analysis of DairyBio's forage program found the annual benefit to dairy farmers from this research will be $800 a hectare.

Partnering with commercial breeder and supplier of premium pasture species, Barennbrug ensures DairyBio's research can be adopted on-farm as soon as possible.

After all – the best technology is one that's used by the industry.

Advancing Australia's pasture

Research into plant improvement has run side-by-side with DairyBio's animal genetics studies since the research partnership's inception in 2016.

Many technologies developed as part of the DairyBio forage program are not only becoming a part of Australian dairy farms, but they also deliver significant value to the entire industry.

Forage research achievements

Extending pasture life by up to three years thanks to the discovery and application of novel endophytes to new varieties of ryegrasses

15 per cent improvement to the performance of pastures thanks to endophyte research and commercial application of breeding technology

20 per cent increase in ryegrass dry matter yield thanks to hybrid breeding technologies

Partnering with commercial businesses to deliver hybrid technologies to the market

Accelerating the genetic gain of ryegrass by up to five-times thanks to genomic selection

The world's first gene-edited ryegrass plants

Genome editing has delivered ryegrass with increased digestibility to cross with elite industry germplasm to boost current pasture varieties

Forage program snapshots

Project 1

What Breeding a new hybrid perennial ryegrass

Why Triple the rate of genetic gain in commercial perennial ryegrass breeding program

How Using genomic tools and F1 hybrid experimental parental pools

Who DairyBio and Barenbrug

Details The F1 hybrid ryegrasses bred from experimental parental pools continue to outperform current advanced commercial varieties, according to trial field data in Australia and New Zealand. This improved performance is the benefit of heterosis from the F1 hybrids.
The commercial partner is now using genomics and crossbreeding to design new ryegrass varieties. More field trials will be established for the experimental F1 varieties, with more to be added later. Future work will inoculating next-generation endophytes into cohorts of the initial parental pools to boost pasture performance.

Project 2

What Create ryegrass that performs better and lasts up to three years longer

How Identify endophytes – the bacteria and fungi that live inside a plant— that will improve a plants' performance, including protecting it for insects, and assist with persistence. Use these endophytes in a breeding program to improve the ryegrass without negatively effecting its productivity.

Who DairyBio

Details DairyBio has developed tools and technologies to detect and evaluate endophyte in seed without destructing the seed. Future research will create ryegrass endophyte combinations with specific toxin profiles suitable for use in dairy farming systems.

Project 3

What Transfer F1 hybrid breeding technology into short-term ryegrass

How Add 10 current and future ryegrass variety parental pools to expand the F1 experimental varieties, maintain and improve existing services

Who DairyBio

Details This project will transfer the breeding technology that delivered F1 hybrid perennial ryegrass into short-term ryegrass to expand the benefits for hybrid ryegrass into more commercial cultivars.

Project 4

What Accelerate precision breeding in forage grasses – including *Lolium* and *Festuca spp*

How Use targeted gene editing to rapidly introduce new traits into existing elite breeding lines

Who DairyBio

Details Improving the genetic traits of forage grasses will provide better quality feed for dairy farmers.

Project 5

What Enhance the performance of the most important global agricultural temperate grasses

How Focusing on the plant microbes within the Lolium plants that contribute to its nutrition and protection – beneficial traits – researchers will improve the value of these plants to the agricultural sector.

Who DairyBio

Details Thanks to the identification and characterisation of these microbes, with beneficial traits, researchers can now extend this knowledge of these microbes to commercial partners and deliver benefits back to the farmgate.

Project 6

What Trialling high energy transgenic – genetically modified – perennial ryegrass

How Seed multiplication and grazing trials in Argentina will provide information about how genetics from high energy transgenic perennial ryegrass can be transferred into commercially relevant ryegrass cultivars.

Who DairyBio and The University of Buenos Aires, Argentina

Details The initial trials will be conducted in Argentina under a dairy grazing regime with sheep and cattle.
All the transgene tracking and tracing requirements for safe evaluation of the GM crop, the high energy transgenic perennial ryegrass, has been achieved. The GM seeds that include a relevant elite commercial background have been generated and supplied to the University of Buenos Aires for multiplication and the trials.

Improving perennial ryegrass persistence

Forage feature

Extending the life and quality of dairy pastures

Pastures that persist and resist pests, disease and drought is exactly what dairy farmers need to maintain business profitability.

And now, thanks to the work of the DairyBio forage program, this has become a reality.

Work undertaken by the DairyBio forage program has uncovered new – or novel – endophytes that can increase the persistence of dairy pastures.

In recent years, dairy pastures in many regions required renovation every two years, rather than the historical five years, due to drought, pest, and disease pressure.

Incorporating novel endophytes into new varieties of ryegrasses will extend pasture persistence and help alleviate the cost of pasture renovation, which in 2021 was estimated to be $100 million a year.

Endophytes are bacteria or fungi that live inside a plant and have a mutually beneficial relationship with the plant. This relationship is called symbiosis.

DairyBio scientists uncovered the novel endophyte strains in perennial and short-term ryegrass pastures.

The novel endophytes have been bred into new ryegrass varieties to increase persistence and improve the pasture's ability to withstand pests and disease, particularly in its early establishment.

Breeding is the only way to transfer these novel endophytes into grass seeds.

The seeds are germinated, then the seedlings are inoculated and then researchers test to see if the endophyte has been taken-up by the plant.

Endophyte positive plants are then used for intensive seed production to expand the novel endophyte into plant populations.

DairyBio has delivered this endophyte technology into the commercial market for distribution to dairy farmers.

This research primarily focused on ryegrass, but DairyBio researchers have begun extending the work by evaluating these known endophytes for application within short-term grasses.

Further research will concentrate on determining the compounds generated by endophytes and uncovering how they work to protect and assist the plant.

Scientists hope this insight into the endophyte compounds will improve their understanding of how they work together, enabling selection of a complimentary suite of compounds to further improve the plant's production and persistence.

Future research will also focus on developing diagnostic tools to make testing for endophytes easier, cheaper and faster to aid quicker implementation on farm.

Preliminary DairyBio research, provided to commercial seed production partners for verification, has reduced the endophyte testing time frame from two weeks to one day. This ensures the new technology is available for farm businesses quicker than ever.

WHAT DOES THIS MEAN ON-FARM?

- Time and money savings with reduced pasture renovation
- The fastest-ever genetic improvement in pastures and endophytes
- Dairy farmers can access the best pasture genetics quicker

Precision management with milk mid-infrared spectroscopy

Animal performance

A simple milk sample can provide vital insight into the health and profitability of each cow.

Milk could hold the key to more accurate dairy management decisions, with a sample of the valuable creamy liquid providing information about fertility, pregnancy, metabolic diseases and much more.

MIR analysis has long provided insights into the composition of individual milk samples, including the fat, protein, lactose, and fatty acid profiles.

But now, thanks to DairyBio research, information derived from the milk by the MIR technology could provide more insight into the health and potential productivity of each cow.

Focusing on the future of individual cows could assist farmers to make more informed farm and herd management decisions.

Extending the use of MIR technology was possible thanks to Australian-specific equations and trials completed by DairyBio.

MIR has been used across the globe but for it to have any relevance and accuracy in the Australian dairy industry – the prediction equations must reflect local farming systems.

The DairyBio MIR equations consider the effect of genetics, feeding and management.

Optimising technology to support individual cow management drives on-farm profitability by reducing health and welfare costs through better genetic selection and developing and enhancing proactive management tools.

Research into using MIR and other on-farm data to predict fertility correctly identified the 10 per cent of cows that were least likely to conceive from the first insemination with an accuracy of 0.75.

Trials are ongoing, but the on-farm applications of MIR technology look promising with opportunities to better identify more fertile cows to breed with sexed semen.

Breeding the most fertile cows with sexed semen could increase the number of heifers born per straw of sexed semen used. This would decrease the cost of breeding and require less cows to breed heifer replacements, providing more scope for dairy-beef production.

DairyBio projects have also found MIR could be used to predict the risk of a cow developing a metabolic disease post-calving.

Research continues into the use of MIR to map the genes effecting milk composition to increase the reliability of Australian Breeding Values and provide farmers with greater bull selection confidence.

DairyBio is committed to advancing Australia's MIR research as using this technology to assess and predict a dairy cow's health and productivity is cheaper and less intrusive than other options. It also delivers large volumes of valuable phenotypic data.

WHAT DOES THIS MEAN ON-FARM?

Better fertility prediction

- Rank a herd from the most, to the least likely to get-calf early in the breeding period
- Optimise the use of sexed semen by targeting the most fertile cows
- Reduce breeding costs
- Increase dairy-beef opportunities

Early disease detection

- Cut disease costs post-calving
- Healthier animals
- Better chance of reproduction success
- Increase the reliabilities of Australian breeding values
- Improve bull selection confidence

The future of dairy science

DairyBio and DairyFeedbase PhD program participants

Ian Tannenbaum

La Trobe University

Current role Research Scientist, Agriculture Victoria

PhD title An assessment of intergenerational microbiomes of *Lolium perenne*

Industry benefit Improve the quality of Australian pastures following the discovery of isolated bacteria that has fungicide and plant growth-promoting compounds. These beneficial strains can be engineered into bioprotectants or biofertilisers.

Priyanka Reddy

La Trobe University

Current role Research Scientist, Agriculture Victoria

PhD title Development of screening assays for determining toxicity of grass-associated fungal endophytes

Industry benefit Provides a better understanding of the safety of novel endophytes that lead to 'ryegrass staggers' and the optimum levels of possible bioprotective compounds in pasture. This will enable the delivery of safe, persistent, and robust pasture for the dairy and meat industries.

Abdulqader Jighly

La Trobe University

Current role Research Scientist, Agriculture Victoria

PhD title Simulating the theoretical evolution of polyploid crops with an application to modern breeding programs

Industry benefit Enhanced the development of tall fescue by using software to model and inform the optimal breeding scheme that combines speed breeding and genomic selection, while also providing an alternative to current conventional breeding programs.

Rafael Narancio

La Trobe University

Current role Research Scientist, National Institute of Agriculture Research, Uruguay

PhD title Transgenic white clover plants with a molecular stack of traits for delayed leaf senescence, aluminium tolerance, and alfalfa mosaic virus resistance. Generation and molecular and functional characterisation

Industry benefit Increase the persistence of white clover and the reliability of forage yields – even in challenging conditions.

Mijail Andrei Karpyn Esqueda

La Trobe University

Current role Program Support – Feedbase: Farm Profit and Capability, Dairy Australia

PhD title Bioassays for assessing effectiveness of epichloë-endophytes in pasture pest control

Industry benefit Established more research was needed to uncover 'which one is the best endophyte?'

Josie Garner

The University of Melbourne

Previous role Research Scientist, Agriculture Victoria

PhD title The physiology and functional genomics of the heat stress response in dairy cattle

Industry benefit Validates the genomic selection for the world-first heat stress breeding value in dairy cattle.

Nicholas Paul Collinson

La Trobe University

Current role Technical Officer, Invertebrates and weeds team, Agriculture Victoria

PhD title Investigating tri-trophic interactions between aphids, perennial ryegrass and fungal endophytes

Industry benefit The bioassay method developed will be used as part of the novel endophyte pipeline as an early testing method for insecticidal activity before use in field trials.

Paula Giraldo

The University of Melbourne

Current role Plant Biosecurity Contingency Planning Officer, Agriculture Victoria

PhD title Application of new technologies in the safety assessment of genetically modified feed

Industry benefit Enable the delivery of safe and improved feed to enhance agricultural profitability, ensure efficient usage of natural resource and decrease environmental impacts.

Innovation generation – how dairy attracts the best and brightest

Leading research

Solving on-farm challenges with science to improve the profitability of Australian dairy

The dairy industry owes a lot to its scientific partners.

Australian Breeding Values, genomics and persistent ryegrass are just some of the innovations generated by researchers and used daily by farmers.

But attracting the best minds to work in the dairy industry isn't always a given.

It requires an ongoing commitment to quality science, pathways for students to develop research and engagement with the farming and processing sector.

DairyBio understood this.

And that's why it introduced its unique and sought-after PhD program.

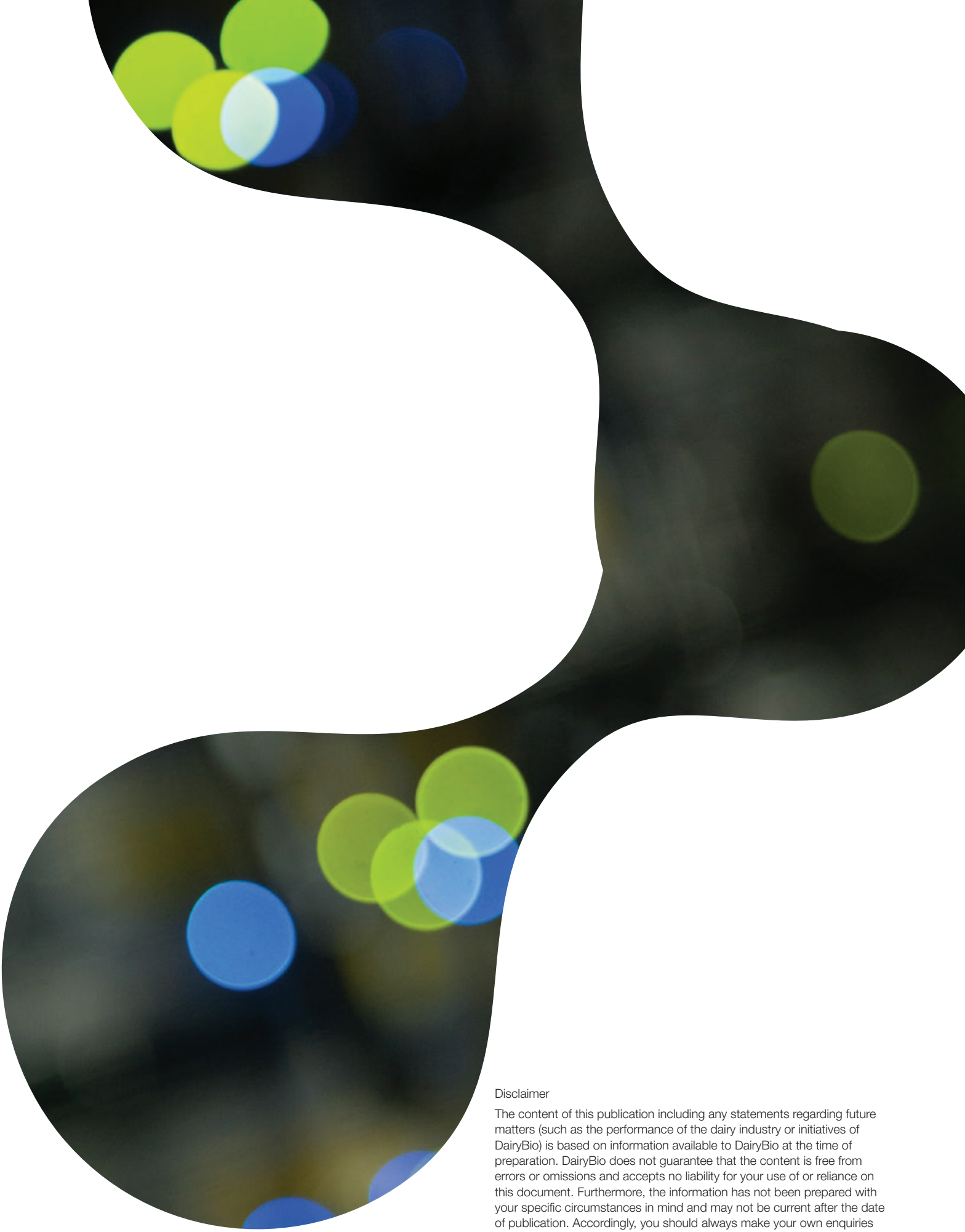
This program, encompassing DairyBio and DairyFeedbase provides early career researchers – those who have usually graduated from Master studies and are looking to pursue PhD candidature – with meaningful research projects complemented by professional development opportunities.

World-renowned Agriculture Victoria researchers lead the programs and projects, while mentoring programs pair each PhD student with an experienced industry mentor.

Maintaining Australia's position at the cutting-edge of dairy innovation means the industry must attract, nurture, and retain the next generations of leading dairy researchers.

The PhD program does this while also ensuring the most talented researchers are working to improve dairy industry profitability.

A true win-win.



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DairyBio ABN 24 141 180 805
AgriBio, Centre for AgriBioscience
5 Ring Road, La Trobe University
Bundoora, Vic 3083
dairybio.com.au

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