Wool at AgResearch

The evidence and knowledge enabling wool's resurgence

agresearch
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Introduction

New Zealand is ready for, and in need of, a resurgence in the value of wool.

AgResearch holds world-leading expertise in the consumer-relevant attributes of wool, and the farm systems that create it. We are poised and ready to provide the robust evidence and innovative knowledge required to support the next Lanaco, Keraplast or Woolchemy to achieve its goals.

This document provides insights into AgResearch's capability, throughout the value chain, to support our wool industry and to develop the knowledge and products that will lead to a successful and sustainable future.

Demonstrating the value of wool through science evidence

We undertake research to understand, quantify and enhance the benefits of wool in consumer products – benefits in product performance, environmental impact and even human safety and wellbeing.

Biodegradability

AgResearch has investigated the biodegradation behaviour of wool over many years including differing situations and environments. Recently we established that wool is readily biodegradable in the ocean. This is a key component of the wool story, providing consumers with confidence that wool does not contribute to the world's increasing microplastic pollution crisis.

Fire resistant textiles

AgResearch has demonstrated the naturally fire-resistant qualities of wool-rich fabrics, making them far superior to synthetic fibres in reducing flammability. This evidence encourages the use of wool in aircraft carpets and upholstery, building insulation, and protective clothing in a range of industries including metal smelting, motor sport and first responders.

Anti-odour capabilities

We have demonstrated that unlike synthetic products, wool apparel does not get smelly when worn repeatedly. This signals an emerging environmental benefit for wool due to the reduced need for laundering. This is the subject of ongoing research.

Recently, we extended this research to pet odours. The odour levels of wool, nylon and polyester carpets were tested by using them as the bedding for a pack of hunting dogs. After three months, odour levels were tested using SIFT-MS (selected ion flow tube mass spectrometry). Wool outperformed the synthetic products, remaining significantly less odorous. This identifies wool as the ideal choice for interior textiles for pet owners as it reduces odour in the home.

End of life carpet recycling

We performed and published the first scientific demonstration of carpet-to-grass recycling. This study showed that shredding post-consumer carpets for use as a fertiliser and soil conditioner is a viable closed-loop recycling option, and that wool products are a natural fit with the concept of the circular bioeconomy.

Two

Genetic Improvements

AgResearch are leading the development of new genomic and phenotyping tools while utilising established digital platforms to support breeders and producers.

Easy care sheep

AgResearch developed a breed of low-cost, easy-care sheep which halves shearing time while still producing 70% of the wool of previous flocks.

These aptly named 'Easy Care Sheep' have genetically short tails and wool-free heads, legs, bellies and breeches, making them five times less likely to get flystrike. Without oddments to manage, lower costs ensue due to the quicker shearing and reduction in shed hand staff.

Our scientists develop and validate technological advances to improve a range of heritable traits; from resistance to internal parasites and facial eczema, to fibre bulk and strength, and attributes such as meat and skin(leather).

Utilisation of the Growbulk breed

The Growbulk breed developed by AgResearch enjoys better lamb survival and good growth rates, resulting in increased meat production and a premium high-bulk reduced-micron wool clip.

Growbulk sheep incorporate the genetic strengths of the high fertility, high fleece weight Romney with the high bulk fleece Poll Dorset and Texel. Increased utilisation of this breed will increase efficiencies in sheep farming.

Effective Wool Production Systems

Our researchers have skills in a wide range of disciplines that can affect the quantity and quality of wool produced from a farm. These include an understanding of soil processes, pasture production and grazing management as well as animal health, reproduction and welfare.

Wool production systems

Wool quality attributes and the quantity produced, along with the resulting greenhouse gas emissions, can be significantly influenced by the farming system and management decisions imposed on that system. For example, we have discovered that some forages minimise dags in lambs, preventing flystrike and reducing farmer inputs.

Control of ectoparasites

We work with breeders to develop capability in ectoparasites and their control. Currently, we are investigating insect pathogens to control the blowflies which attack sheep. Several approaches are showing promise through targeting either the host-seeking adult flies or the over-wintering larval/pupal stages in soil.

Rather than being used as a replacement for current chemicals, it is likely these pathogens will help reduce the number of blowflies on the farm, working in concert with other control options to reduce the prevalence of fly strike.

Farm systems analyses

AgResearch scientists use farm systems models to examine the various combinations of landuse areas, stock classes, forage types and other parameters that will optimise returns. They can then work with farmers in case studies to test these options and implement them where practical.

Meeting fresh water and greenhouse gas targets

Determining the footprint of the farming operation is now an essential task in farm planning and auditing – both for legislative and market requirements. Our researchers have a wide range of tools to measure and estimate losses of nutrients and gases to air and water, as well as calculate the footprint of wool from the farm to the final product purchased by the consumer.

Four

Wool Protein Science

Wool has the most complex structure and the most versatile properties of all textile fibres. It is formed by the composition, organisation and reactivity of molecules' nano and micro-structures.

Demonstrating our strong commitment to wool, AgResearch has invested heavily in scientific instrumentation. Our scientists are equipped with a range of advanced techniques including proteomics, spectrometry, spectroscopy, electron microscopy, electron tomography and computational modelling.

Improving understanding of wool fibre

AgResearch and our predecessors have long been at the forefront of the fundamental science of wool, which underpins our applied research and new product development.

For example, the properties of the three cortical cell types, along with their relative abundance and 3-dimensional arrangement were established in the 1980's, which significantly improved understanding of the determinants of fibre diameter and intrinsic fibre strength. The findings enabled staple strength, which is easily measured, to be used as a predictor of the harder to measure fibre strength, enhancing the progress of sheep breeding programs.

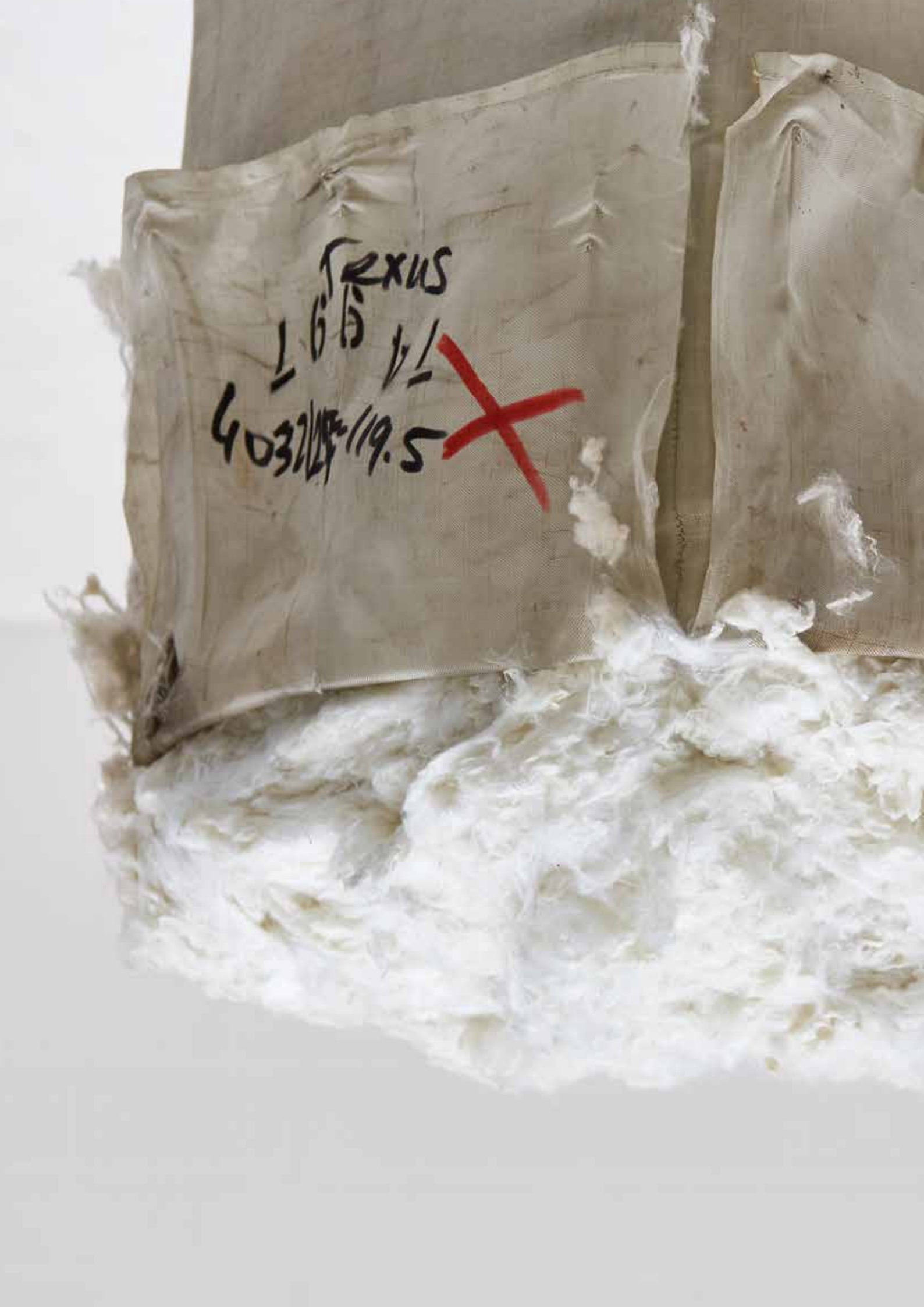
Recently, we have been successful in determining the definitive levels of repeating structures inside the fibre, and how they twist together.

Development of new wool keratin-based materials and manufacturing technologies

Development of new materials starts with controlled deconstruction of the fibres into cellular or molecular components. They are then reassembled by, for example, additive manufacturing techniques such as 3D printing, electrospinning to produce nanofibre assemblies, or the creation of biocomposites and hybrid materials with other biomolecules.

→ **These new materials are used in biomedical applications where they can exploit the inherent biocompatibility of wool keratin with the human body.**

An example is intextile-skin interactions, demonstrating how different fibre types influence skin health (including the skin microbiome), and the wearer's thermophysiological (moisture and heat management) and sensory (e.g. stickiness, prickle) comfort.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Wool Fibre and Textiles

As well as our extensive laboratories, AgResearch wool and fibre scientists have access to a well-equipped pilot-scale fibre processing plant enabling discoveries made in the laboratory to be rapidly tested on a large scale. We cover wool fibre processing right from greasy wool to fabric.

Widening wool's use in apparel

AgResearch develops concepts and technologies to widen the application of wool in apparel use. One example is a technique to impart a 'distressed' look to wool apparel, broadening wool's appeal in casual apparel. Another example is a 'mercerised' merino process applicable to fabric, which increases lustre giving a more luxurious handle and appearance This approach also improves wool's already high resistance to bacteria and the odours they cause.

Prevention of early fading and bleaching

While it is a remarkable fibre, wool can have some comparative drawbacks against synthetic counterparts. Our research overcomes these. As an example, when new wool carpets are installed and exposed to light, particularly sunlight, visible colour changes can occur, especially in pastel shades. Our research created solutions such as the introduction of Lanalbin, a patented technology for eliminating photobleaching.

Multi-functional wool fabrics

AgResearch has developed processes enabling, for the first time, intricate designs to be applied to wool fabric by transfer printing, and bright basic-type dyes to be applied to wool. Using graft-copolymerisation, wool fibres become multi-functional, enhancing their potential uses.

Country/region of origin traceability

As New Zealand looks to mature in the marketing of its wool, proof of origin is becoming increasingly important to deter substitution by inferior wool types. AgResearch has developed isotopic tracer technology which exploits the unique isotopic fingerprint of its geographical source – a fingerprint that survives through to the finished product.

Fibre quality specifications

Significant value is created through wool fibre quality certification. This is often done using spectrometry and colorimetry techniques that were developed by AgResearch and its predecessors.

Wool scours in New Zealand now use AgResearch's VIS/NIR spectrometry for process control and consignment building by rapidly determining moisture, level of residual grease, whiteness and brightness, while top and yarn spinning plants use colorimetry to meet the colour specifications stipulated by their clients.

Our research capabilities includes:

State-of-the-art genomic tools

Our world-class geneticists have developed state-of-the-art genomic tools to breed high-performing sheep. This includes using molecular and statistical techniques to isolate genes that could have an important effect on wool quality, quantity or other traits affecting wool production.

On-farm knowledge

On-farm knowledge of wool production, including impacts of soil, plant and animal management on wool quality and quantity.

Farm systems analyses

Farm systems analyses of effective strategies for wool production, including the most appropriate land-areas of the farm, sheep breeds and forage varieties to optimise returns and minimise emissions of nutrients and gases to air and water from wool production operations.

Textile and polymer chemistry

Textile and polymer chemistry, including colouration and finishing technologies. This extends beyond wool to other biopolymers that can be used in combination with wool, such as lignin.

Fibre modification

Fibre modification to add functionality and enhance performance, such as resistance to stains and fire, and novel coloration effects, or to impart super-absorbency.

Textile technology

Textile technology, processing and structures for product development.

Yarn technologies

Yarn technologies and fabric for new applications such as footwear or filtration.

Verification

Verification and demonstration of product attributes, especially non-standard tests and user trials. Product attributes include odour resistance, moisture management, fire protection, and real-world durability. We have well-developed protocols and reliable pools of volunteers for user trials.

Process engineering

Process engineering, including sustainable processing that reduces chemical and energy use. We also have development engineering capability such as the Kiwiscour at our disposal to develop new instruments and processing equipment.

Instrumentation

Development of instrumentation for materials specification, process and quality control.

AgResearch Limited
NZBN: 9429 038 966 224

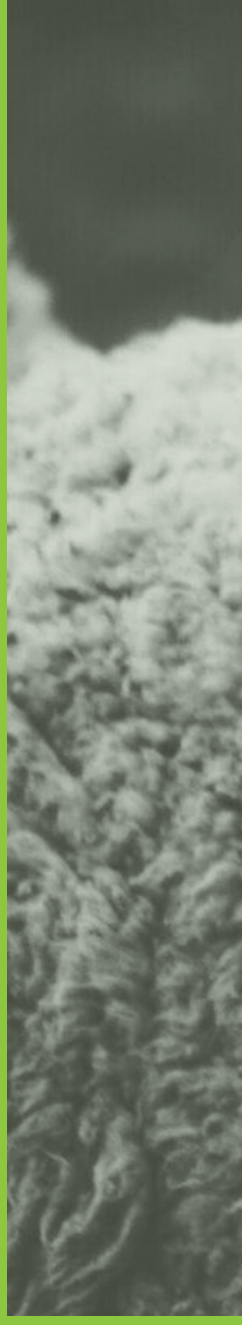
Lincoln
Corporate Office
Lincoln Research Centre
1365 Springs Road
Lincoln 7674
Private Bag 4749
Christchurch 8731
T +64 3 321 8731

Hamilton
Ruakura Research Centre
10 Bisley Road
Hamilton 3214
Private Bag 3123
Hamilton 3240
T +64 7 856 2836

Palmerston North
Grasslands Research Centre
Hopkirk Research Institute
Te Ohu Rangahau Kai
Tennent Drive
Palmerston North 4410
Private Bag 11008
Palmerston North 4442
T +64 6 356 8019

Mosgiel
Invermay Agricultural Centre
176 Puddle Alley
Mosgiel 9092
Private Bag 50034
Mosgiel 9053
T +64 3 489 3809

www.agresearch.co.nz



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