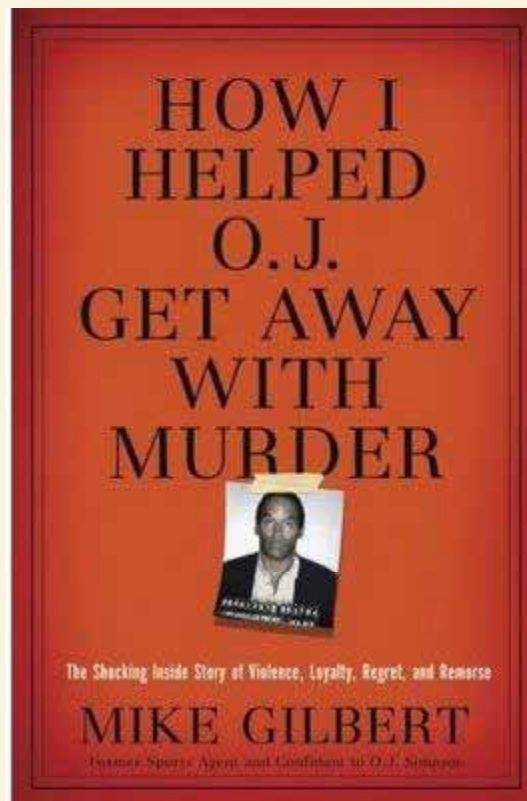


# Application of DNA technology in dairy farming.

Richard Spelman

# DNA Era


- Forensics



## Falsely imprisoned: David Dougherty's story

- Sunday Star Times

Last updated 19:52 07/03/2009

 Text Size

 Print



DAVID DOUGHERTY recently reminded journalist Donn Chisholm of the promise she made the first time he called from prison.

"He said I'd told him, 'I'm going to write a story about you week until you're out'. And he was kind of comforted by that."

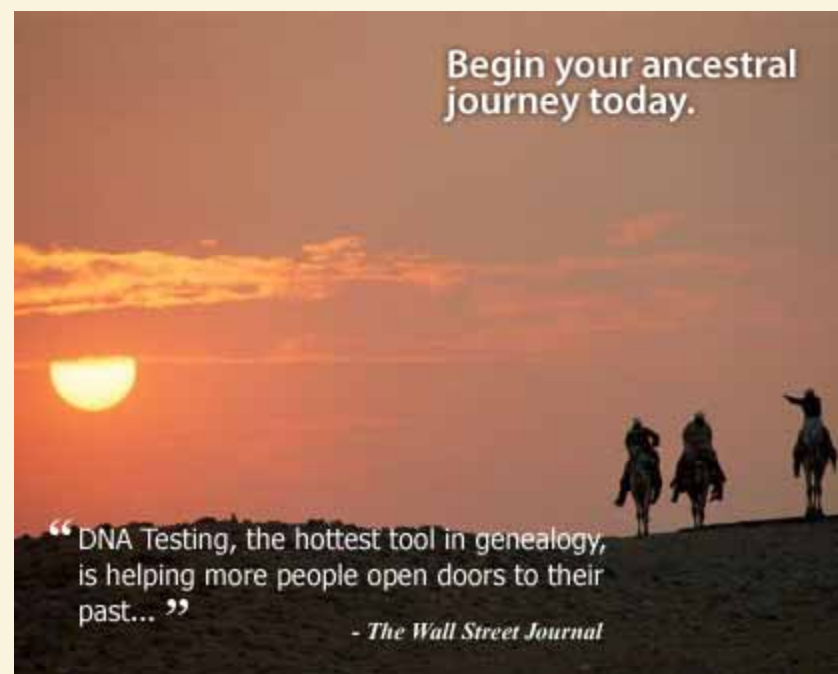
The Sunday Star-Times reporter kept faith with the man imprisoned for the abduction and rape of an 11-year-old girl. Twenty articles were published over five months until David won a retrial: "Mother's tears of joy as son returned," said headlines.

# DNA Era

- Ancestry

## **DNA ANCESTRY PROJECT: Trace your ancestral origins.**

Learn more about your ancestors, where they came from, and their ethnic origins. Studies have shown that all of us shared a common ancestor who lived in Africa approximately 65,000 years ago. As time passed, our ancestors migrated out of Africa into the Middle East, Asia, Europe, North America, and other parts of the world. During this period of time, mutations occurred in their DNA, and each mutation links our ancestors to a specific time and place in history. By participating in the DNA Ancestry Project, you will embark on a dynamic journey to discover your ancestral origins.



# DNA Era

- Ancestry

*Mixed breed got you*  
**PUZZLED?**



*Fill in the missing pieces  
with **DOGGIE DNA!***

**The Canine Heritage® Breed Test**, developed by a recognized leader in DNA technology, can help unravel the mystery of your mixed-breed pup. How often have you been asked: What kind of dog is that? This DNA-based diagnostic test can give you the answer by comparing your dog's DNA to over 100 of the most popular breeds.

Satisfying curiosity and having fun might be what draws you to the test at first, but it's not the only reason. To see what else you can learn from having your dog DNA tested, [click here](#).

Your Certificate of DNA Breed Analysis is your proud memento of the make-up of your best friend. The DNA results are reported in three

# DNA Era

- Parentage



GeneMark®

NIMBL  
DIAGNOSTICS  
NEW ZEALAND

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## Paternity Testing

A simple, painless mouth swab is all that's required for a DNA paternity test which will exclude paternity with 100% accuracy, or show paternity with >99.99999% accuracy.

Nimble Diagnostics is the trusted name in New Zealand for DNA testing. All testing is performed in laboratories fully accredited by the AABB, ISO 17025, and NATA. All results are guaranteed.

**Warning:** Several companies offer cheap paternity tests, but these are usually non-accredited, non-regulated companies that cut costs by using much less accurate testing procedures. **Always** ensure you use a fully accredited laboratory. [Learn more...](#)

From

\$389

NZ\$, including ALL costs


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# DNA Era

- Health

The screenshot shows the deCODEme website's health section. At the top is the deCODEme logo and a navigation menu with links for 'How deCODEme Works', 'Health', 'Ancestry', 'Genetics Explained', 'Try Demo', 'Store', and 'Login'. Below the navigation is a large banner image of a woman in a lab coat. To the right is a testimonial from Chuck Wallace, a deCODEme customer, with a photo of him and his wife. Below the banner are three product cards: 'deCODEme Complete Scan', 'deCODEme Cardio Scan', and 'deCODEme Cancer Scan'. Each card includes a description of the scan and a 'Go To Store' button. To the right of these cards is a section titled 'Scientific leadership' and 'Accuracy and reliability' with links to read more.

deCODEme  [How deCODEme Works](#) [Health](#) [Ancestry](#) [Genetics Explained](#) [Try Demo](#) [Store](#) [Login](#)




## deCODE your health

**Calculate genetic risk – Empower prevention**  
your genes are a road-map to better health


**Discover your ancestral roots**  
your genetic relationship to world populations

**News >** [Discussing Genetic Risk Testing on Martha Stewart Show](#)

**Introductory price from \$195 USD**  
[Go To Store](#)




**”...Dr. Bale had the foresight to suggest that we do run the genetic test. I think it very possibly saved my life...”**  
Chuck Wallace, deCODEme customer [»» read our customer stories](#)



**deCODEme Complete Scan**

Discover your Genetic risk for 39 diseases and traits ranging from Heart Attack and Diabetes to Alcohol Flush Reaction.


[»» our Complete Scan](#)



**deCODEme Cardio Scan** NEW

Discover your genetic risk for the most common types of cardiovascular diseases, including Heart Attack and Atrial Fibrillation.

[»» our Cardio Scan](#)



**deCODEme Cancer Scan** NEW

Calculate your genetic risk for seven common cancers including Lung Cancer, Skin Cancer, Breast Cancer and Prostate Cancer.


[»» our Cancer Scan](#)

**Scientific leadership**  
deCODE leads the field in the discovery of genetic variants for common diseases

[»» deCODE's scientific discoveries](#)

**Accuracy and reliability**  
We capture more medically relevant genetic variants than our competitors

[»» compare our genetic scans](#)



# DNA Era

- Disease prevention
  - For example BLAD

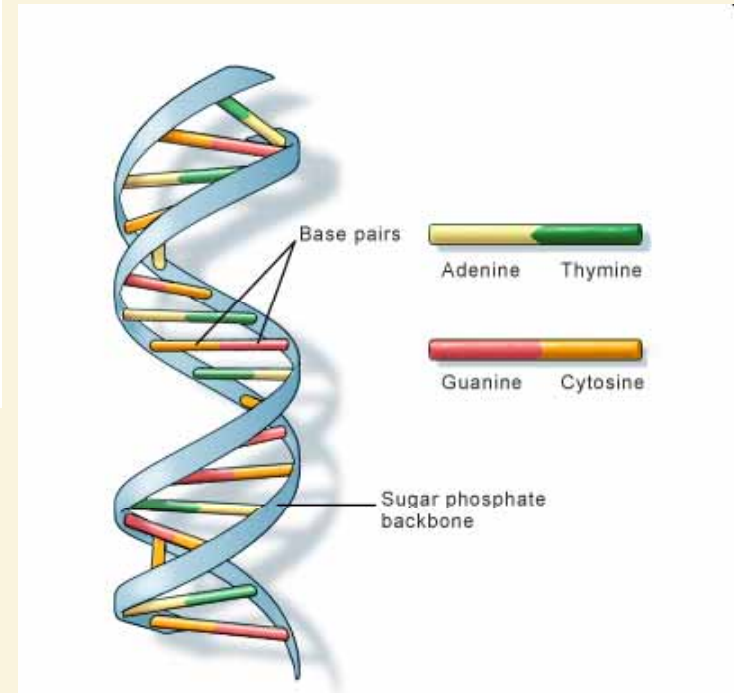
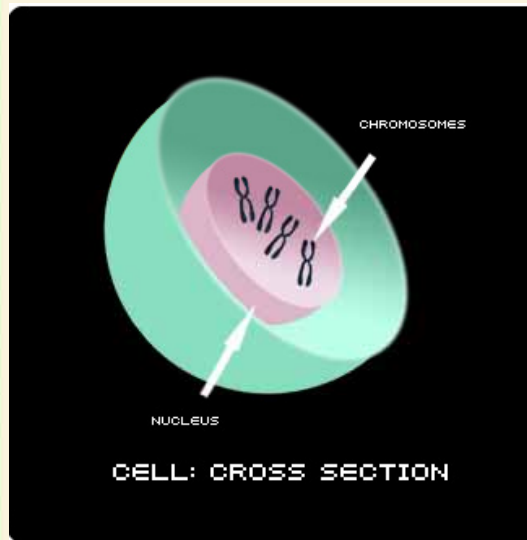


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- Will this technology be used for humans?
  - Already is for Thalassemia disease in Cyprus.

# What is DNA?





# What is DNA?

- 3 billion base pairs in the bovine and human genomes
- Approximately 20-25K genes
- Genes only make up 2.5% of the genome
  - Rest previously thought to be junk
  - Junk DNA now identified as controlling expression of the genes

# DNA applied to dairy farming

- Genetic gain for milk production traits
- Different milk characteristics
- Pasture improvement

# DNA applied to dairy cattle breeding

Animal performance



Variation at the DNA level influences animal performance

If one can identify "important" DNA variation then we can predict animal performance

DNA

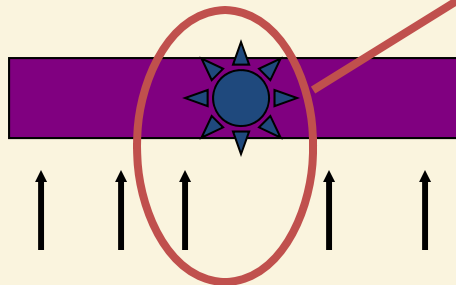
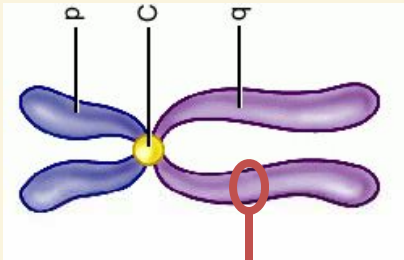
# DNA research undertaken by LIC

- 1994 started research with University of Liege, Belgium and Holland Genetics
- Identified 2 genes that influenced milk production
- Used to pre-screen bulls into SPS
- 2007-08 DNA research delivered

# Why now & not 10 years ago?

- Bovine sequence in 2006
- Before bovine genome sequence
  - 1-5000 genetic markers
  - \$2-3 per animal per genetic marker
- After bovine genome sequence
  - 100,000+ genetic markers
  - Less than 1 cent per animal per genetic marker

# DNA applied to dairy cattle breeding



AATGC.....Prot+

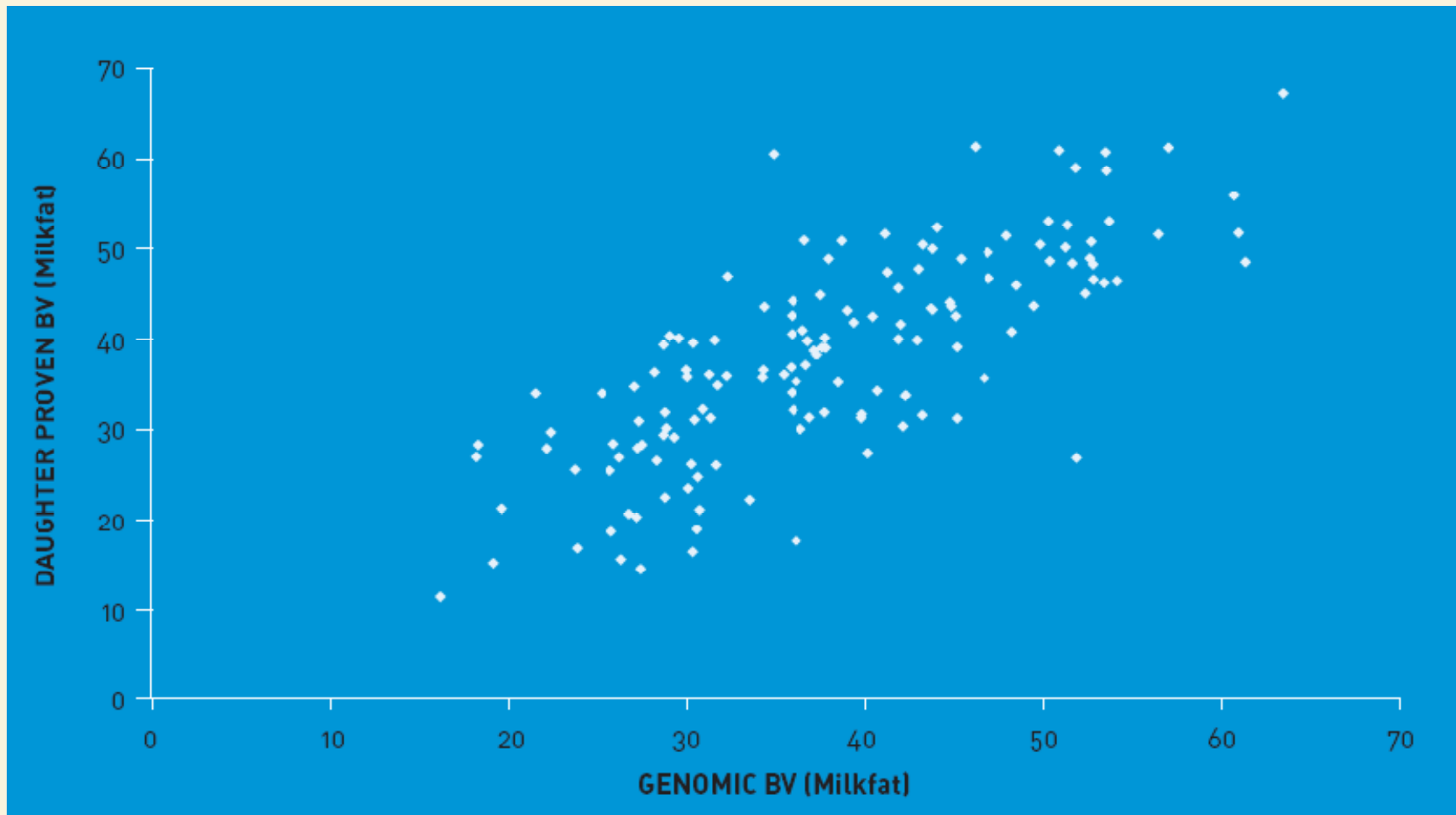
AA**G**GC.....Prot-



Genotype 3000 bulls

- bulls' daughters with T allele average 150kg protein
- bulls' daughters with G allele average 148kg protein

# Genetic merit is well predicted



# DNA proven team

- Bulls sold to farmers as 2 yr-olds rather than 5 yr-olds
- Individual DNA proven sires have reliability of 50-60%
  - Daughter proven 80-85%
- Used in a team increases reliability
  - 97% for team of 16
  - Average of 250 BW
    - 95% of the time will be  $\pm 23$  BW as a team
    - Daughter proven team  $\pm 13$  BW as a team



The world's first large scale  
commercial launch of  
“DNA Proven” genetics

# Size of the prize

- Genetic gain is permanent and cumulative
- “Compounding returns is the greatest mathematical discovery of all time”
- Genetic gain in dairy cattle delivers the bulk of productivity improvement on NZ farms
- Genomics is expected to increase the annual rate of compounding gain by 30-40%
- It is the biggest development in genetics (and therefore on-farm productivity gain) in 60 years

# DNA proven team

- Offered for the first time in 2008
  - NZ, UK & Ireland
- Increased choice for dairy farmers
  - 19% of inseminations by DNA proven team
    - 60% KiwiCross™
- Charge an extra \$5 premium over daughter proven teams
  - Reflects genetic superiority of teams
  - 1 BW for a sire worth ~50 cents to farmer
  - 10 BW advantage break even

# Milk characteristics

**BBC NEWS**

▶ Watch **One-Minute World News**

Last Updated: Tuesday, 29 May 2007, 12:33 GMT 13:33 UK

✉ E-mail this to a friend    🖨️ Printable version

## NZ cows produce own skimmed milk

**Experts at a biotechnology company in New Zealand have discovered that some cows have a gene giving them a natural ability to produce skimmed milk.**



The finding could be used to develop a dairy herd that produces low-fat milk, Chemistry & Industry magazine reports.

A cow with the "skimmed milk" gene was identified in 2001, and the team have since been able to breed calves that also produce the low-fat variety.

They say it could have a significant impact on the dairy industry.

The original cow - called Marge - produces milk that is very low in saturated fats, and so should be high in healthier polyunsaturates and monounsaturated fats.

Milk with this composition could also be used to make more spreadable butter.

Skimmed milk is currently made by removing much of the fatty cream contained in whole fat milk.

About 25% of milk sold in the UK today is full-fat. The rest is skimmed or semi-skimmed (skimmed milk with some fat added back).

Marge was discovered during a screening of milk compositions across New Zealand's four million cattle, carried out by

The finding could one day be used to breed "skimmed milk herds"

**“ When we found her daughters had the gene, that was the eureka moment ”**

Russell Snell, ViaLactia

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# Milk characteristics

GENOMICS

## New: casein and healthy fat bulls

A new denotation for proven bulls is in the pipeline. They will receive the label casein bull or unsaturated fatty acid bull. This is thanks to research conducted by the Dutch Milk Genomics Initiative. The dairy industry can start working with the results today.

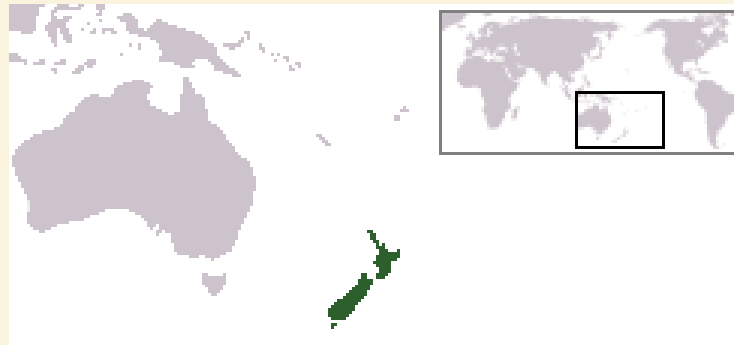
For some time already it has been known that the fat and protein component in milk varies from one cow to the next. Milk fat is made up of a large number of fatty acids. Milk protein consists of a large number of proteins with the largest portion of milk protein (90%) being formed

by the caseins and the whey proteins -lactalbumin and -lacto globulin. Research in Wageningen has determined that not only the components, but also the composition of the milk fat and milk protein varies from one cow to the next. An important part can be attributed to

the differences in genetic make-up. By using specific bulls, the composition of milk fat and milk protein can be influenced. Modern genetics makes it possible to detect such bulls quickly. When farmers use these bulls, they will get cows that give milk which is extremely suitable

# Pasture

- Low-input mixed sward pasture-based farming on most farms
  - 70% perennial ryegrass (*Lolium perenne*) – hardy, palatable, productive, digestible obligate outcrosser
  - 30% white clover (*Trifolium repens*) – leguminous obligate outcrosser

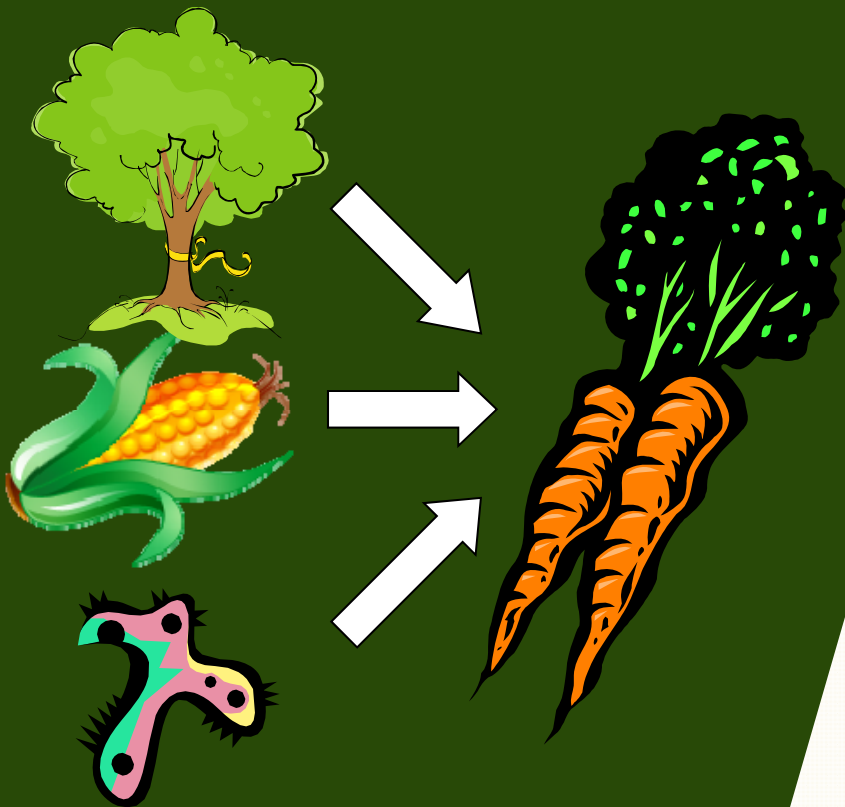


# PG: smart sustainable forages for NZ

- Our Meat, Dairy, Wool and Deer industries **rely on the long-term productivity of pasture** for their international low-cost and high-quality positions.
- Biotechnology will give the **greatest stepwise and sustainable improvement** in pasture productivity. We will use our in-depth knowledge of pasture genomes to **enhance conventional breeding**. And we will use ryegrass genes in ryegrass, clover genes in clover to capture the **untapped genetic potential** in pasture plants.



Transgenic with  
added genes



Cisgenic<sup>®</sup> with  
no new genes





# PG's targets

## PRODUCTIVITY TARGETS - RESEARCH & APPLIED DISCOVERY

Minimum 25% increase in forage biomass from cultivars

More pasture Condensed Tannins to increase animal production

Improved drought tolerance in forages

Increased persistence of clovers

Increased quality of forages

Discover

Develop

Commercialize

## SUSTAINABILITY TARGETS - APPLIED DISCOVERY & DEVELOPMENT

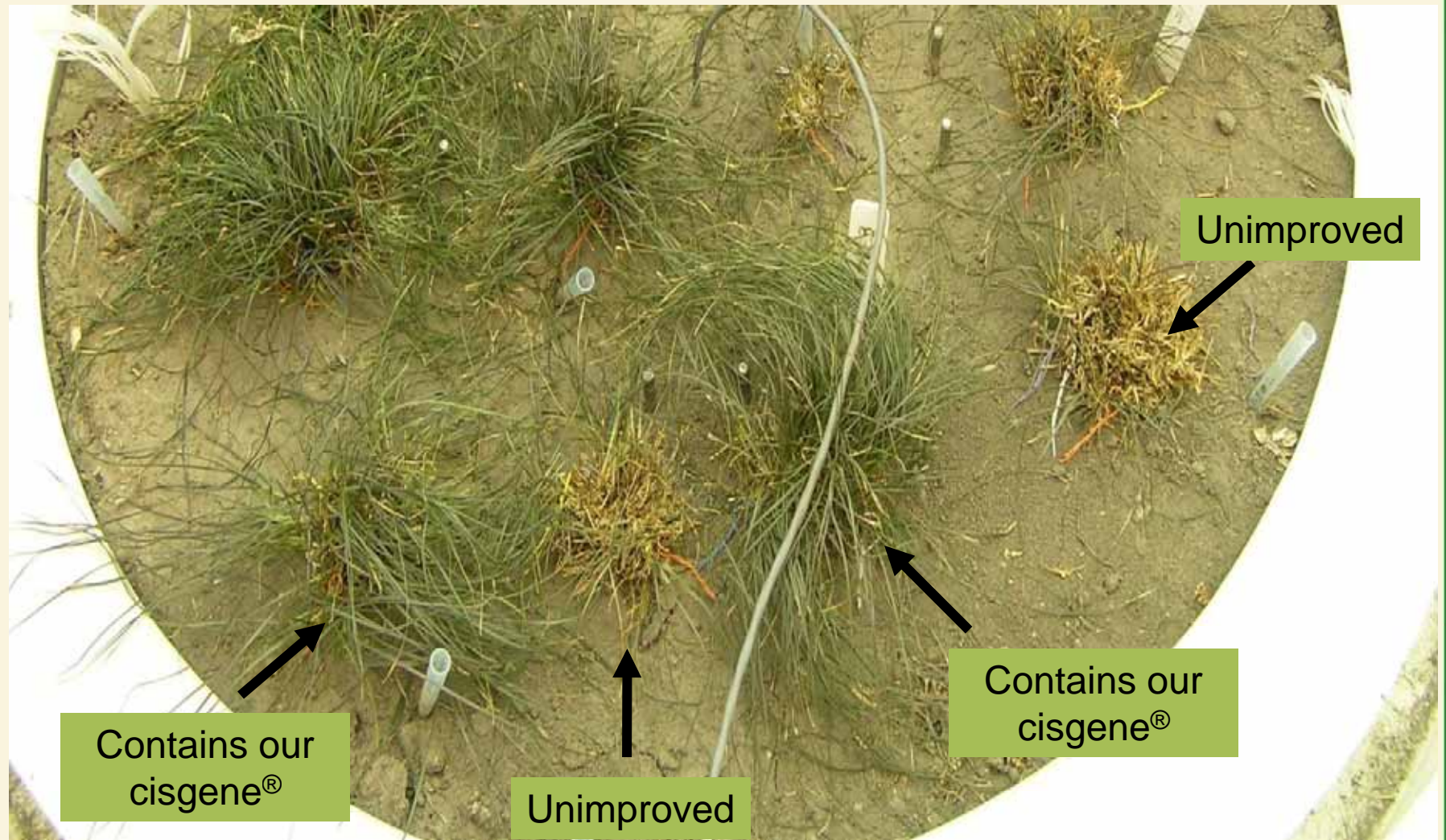
Nitrogen use efficiency

Phosphorus use efficiency

Water use efficiency

Whole-farm biotechnologies

# Drought tolerant cisgenic<sup>®</sup> ryegrass



# What next for DNA technology

- Zinc finger nucleases
- Specific gene extraction
- Use DNA technology to extract a gene or a particular variation of the gene
  - One cell embryo
  - Heritable

# What next for DNA technology?

- Sequencing
  - Human genome (2000)
    - \$4 billion
  - Bovine genome (2006)
    - \$50 million
  - Ovine genome (2008)
    - \$2-3 million
  - Human
    - 1000 genome project
      - \$100K each (2 weeks to complete)
    - \$1000 genome 2012
- Bulls bought by LIC will be sequenced in the next 5-10 years

# Summary

- Living in a DNA era
- Dramatic technology and cost changes over the last 5 yrs
- Utilised the technology with biological resources
- Bulls available to market as 2 yr olds rather than 5 yr olds.
  - Rate of genetic gain to increase by 30-40%
- Cows selected and bred based on DNA profile for specific milk characteristics.
- Pasture enhanced through cisgenics
- Sequencing the next “big” technology
- Life on and off the farm will be affected by DNA