

Genomic selection for beef cattle in Ireland

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Before we go any further

- Genomics is USELESS without the basics!!
 - Pertinent breeding objective
 - EBI & SBV
 - Live and accurate phenotypic database
 - World class breeding program
 - Where are the best cows in the IRL for the IRL??

Present approach



$1/2$

$1/2$



30% reliability
 $\pm \text{€}71$ SBV



Present approach



1/2

1/2



60% reliability
 $\pm \text{€}53$ SBV





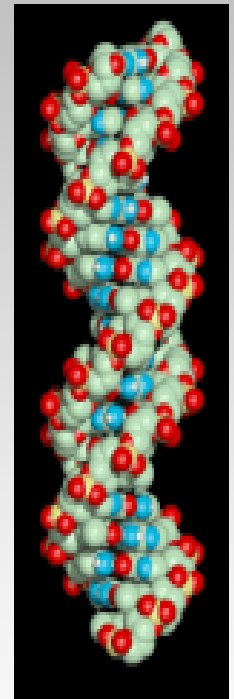
Slogan v Addison



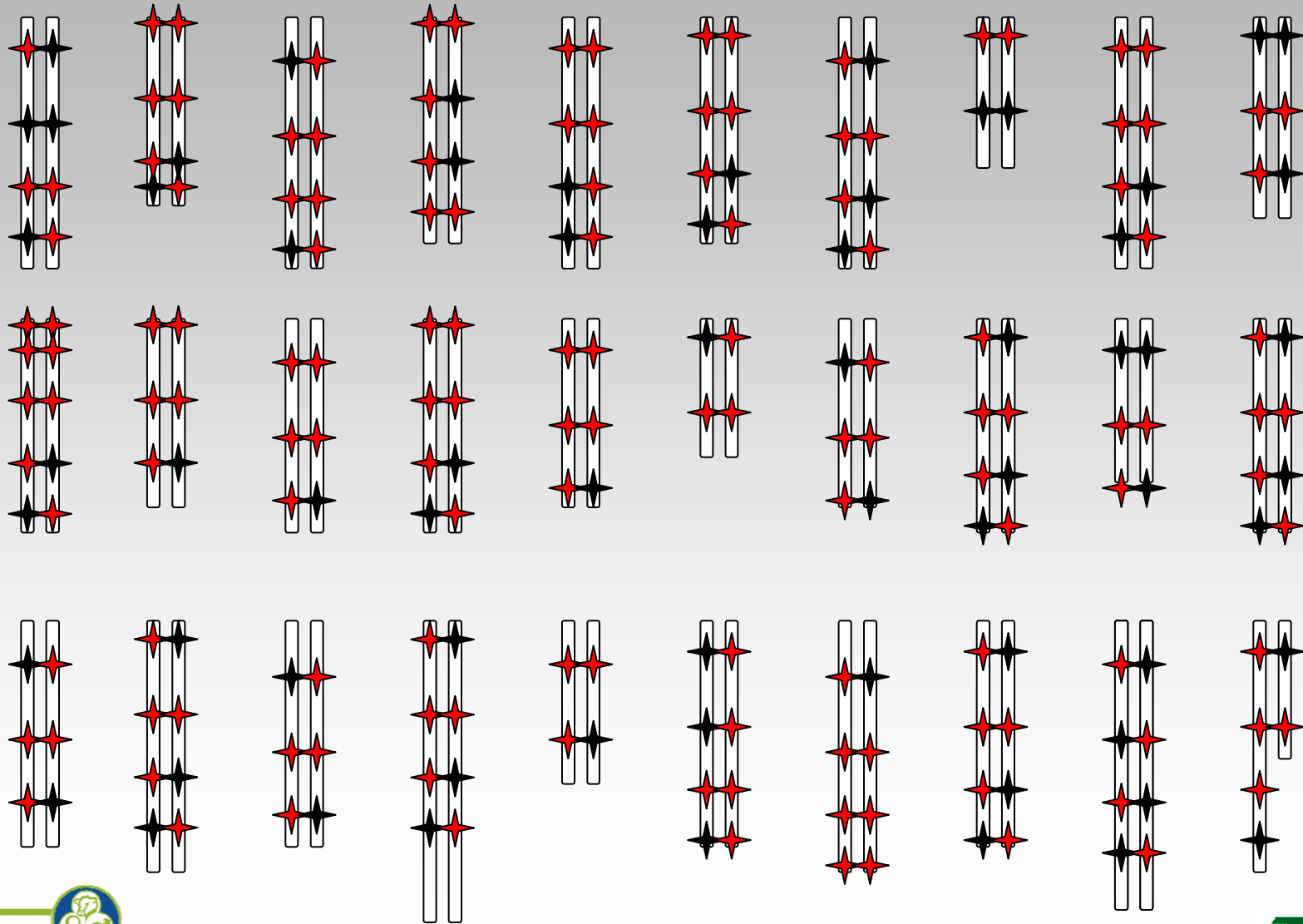
Trait	ESZ	EZA
EBI	€80	€35
Milk kg	64	754
Fat kg	5	8
Protein kg	5	20
Calv. Int.	-2.7	4.42
Survival	0.96	-1.75

Genetics 101

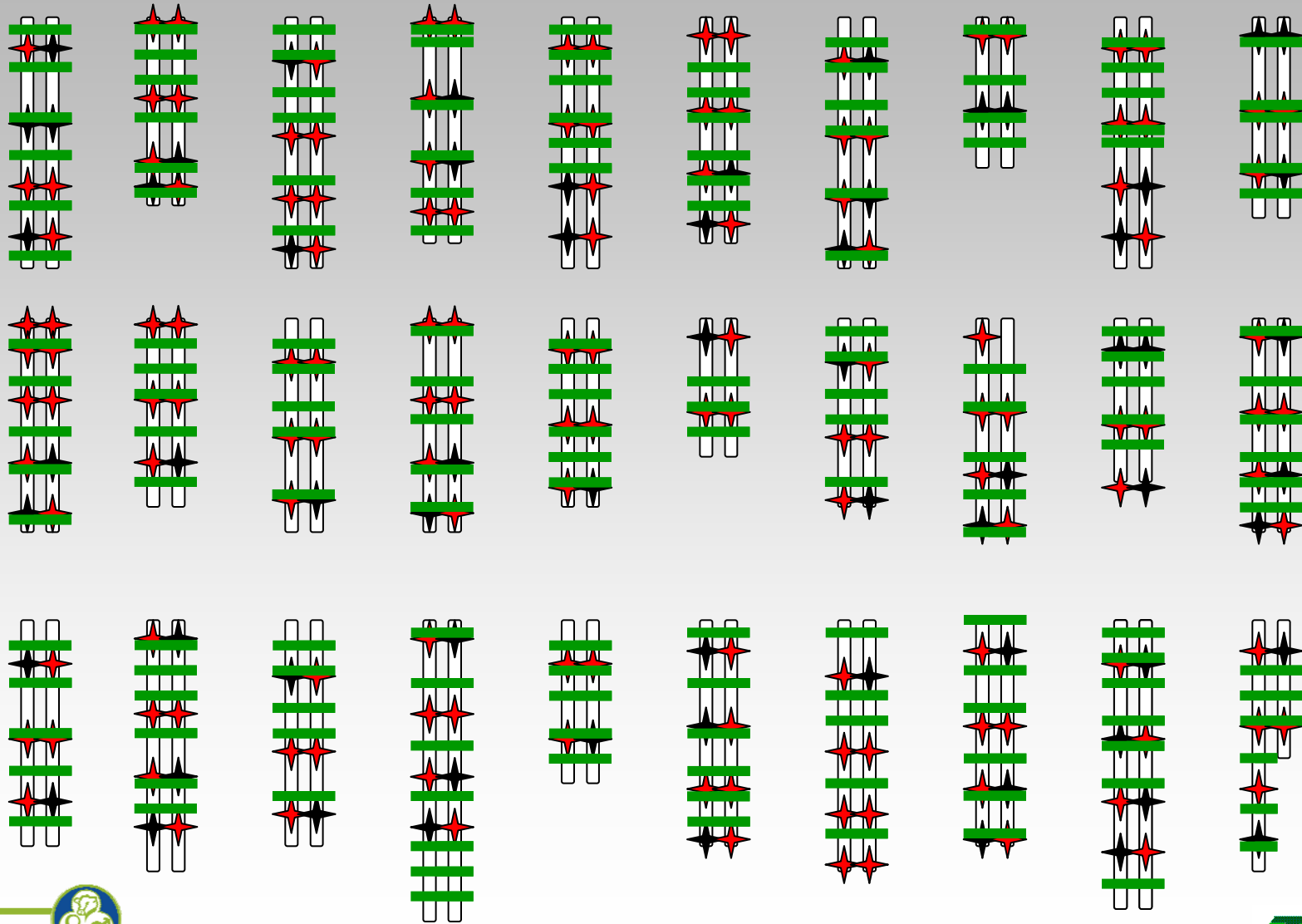
- Everyone has DNA which is unique (except for identical twins)
- DNA remains the same throughout life
- DNA clumps together to make *genes*
- Genes/DNA, interacting with the environment determine whether an animal will grow fast or milk well
- Genetic markers (SNPs – “snips”) are tiny pieces of DNA which can be measured easily in a laboratory



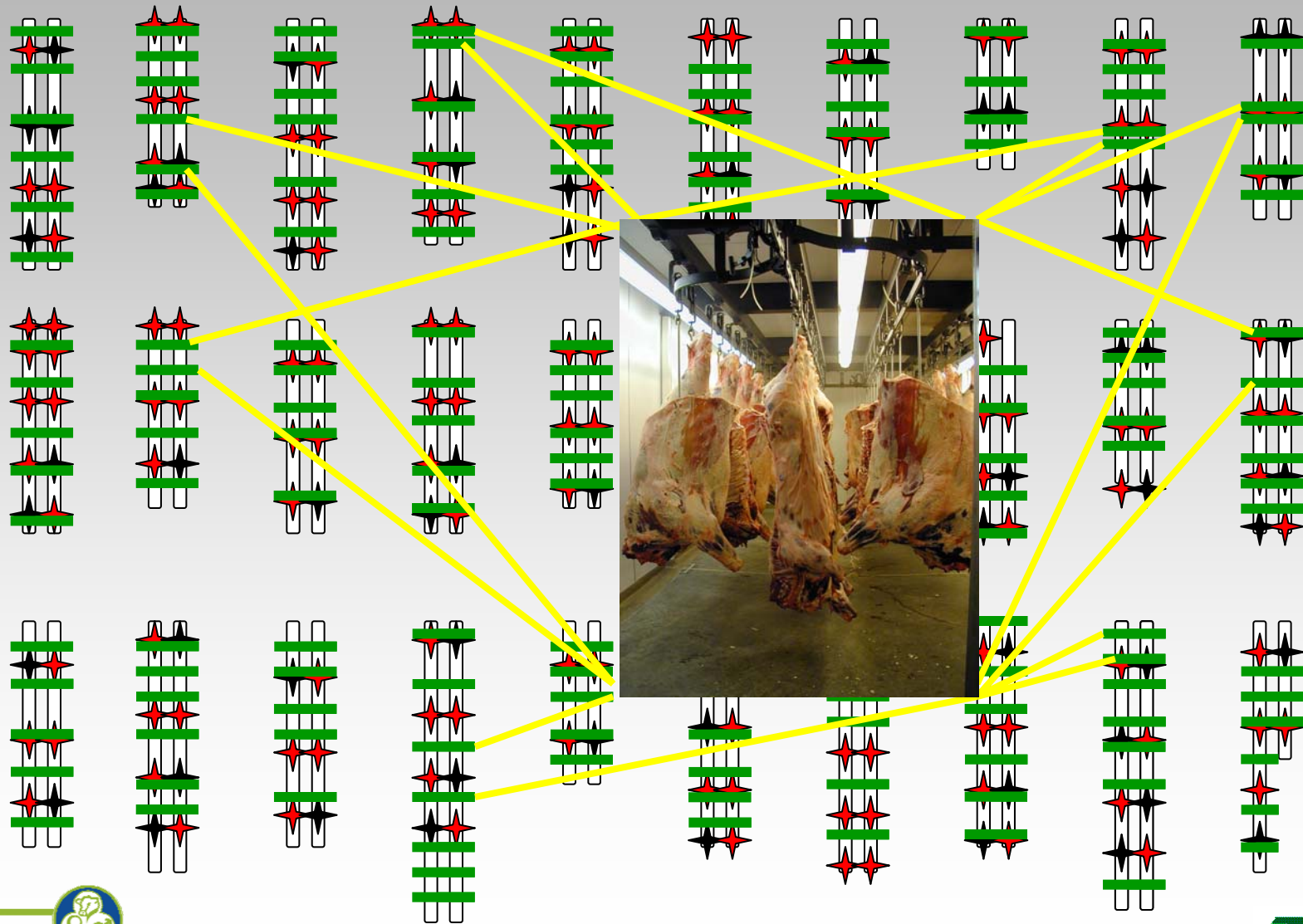
Genomic selection



Genomic selection



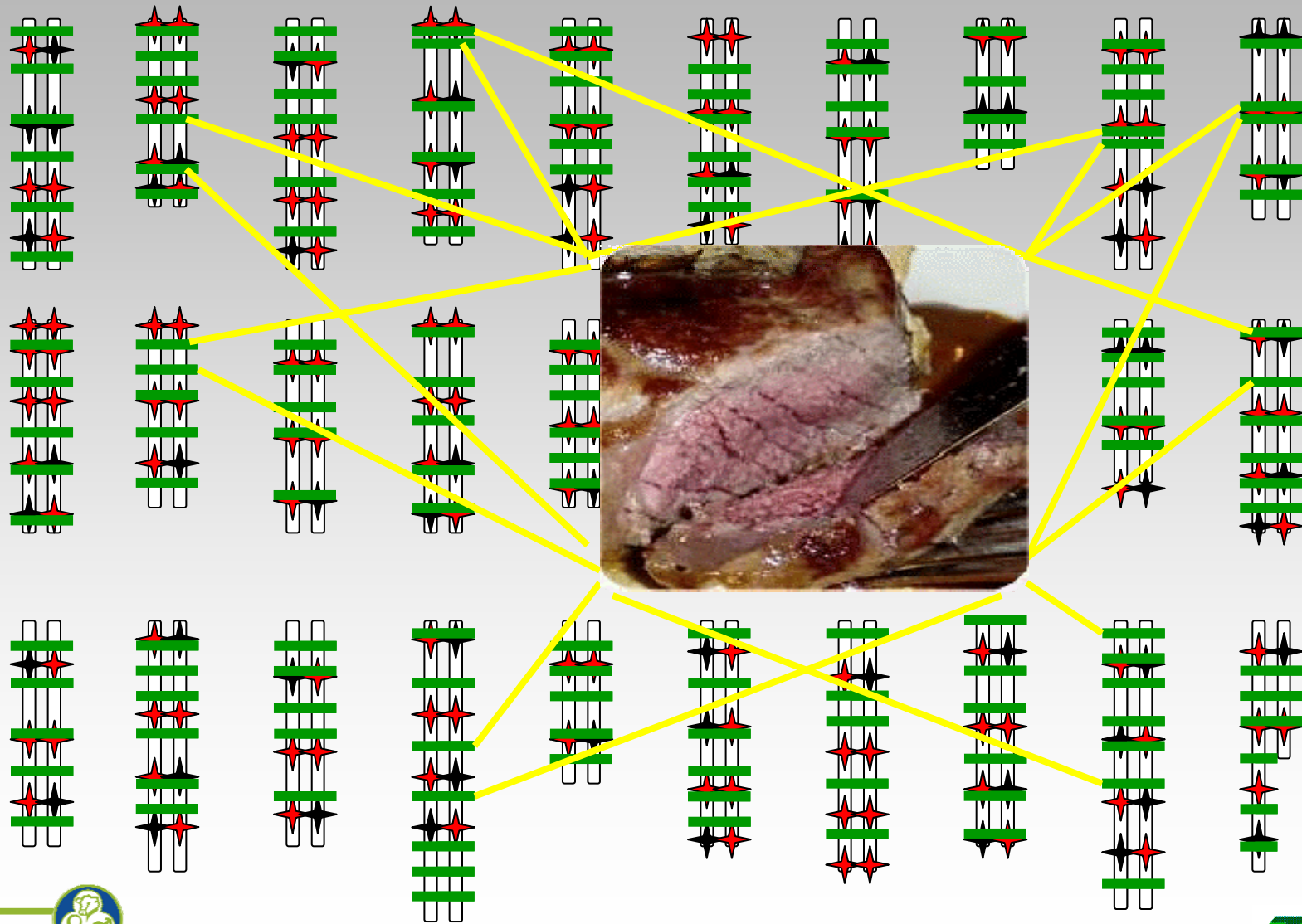
Genomic selection



Genomic selection

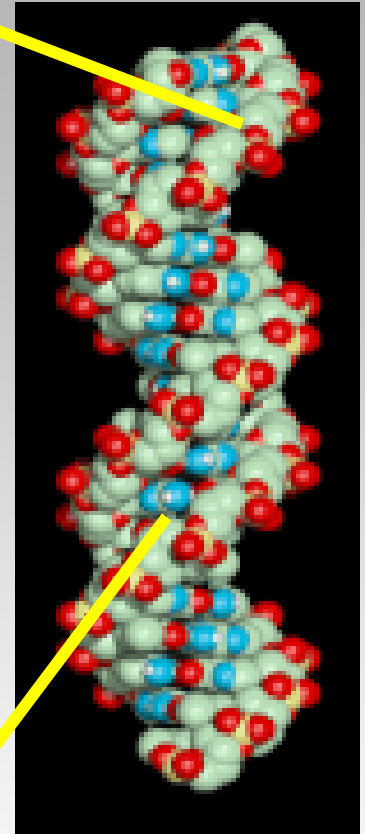


Genomic selection



Gene	Carcass	Calving	Docility
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1	+3	-1	-0.3
2	+2.5	-2	-0.09
3	-0.3	+0.9	+0.3
4	+4	-0.2	-0.54
5	-7	+2	+0.14
⋮	⋮	⋮	⋮
800,000	-14	+3	+1.1



New approach

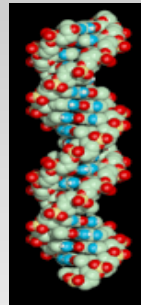


1/2

1/2



30% reliability
 $\pm$ €71 SBV



54% reliability
 $\pm$ €57 SBV

New approach

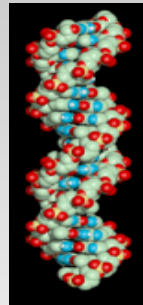


1/2

1/2



30% reliability
 $\pm \text{€}71 \text{ SBV}$



54% reliability
 $\pm \text{€}51 \text{ SBV}$



New approach

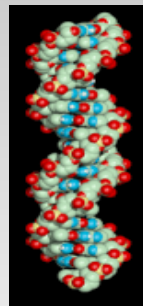


1/2

1/2



30% reliability
 $\pm \text{€}71 \text{ SBV}$



99% reliability
 $\pm \text{€}8 \text{ SBV}$

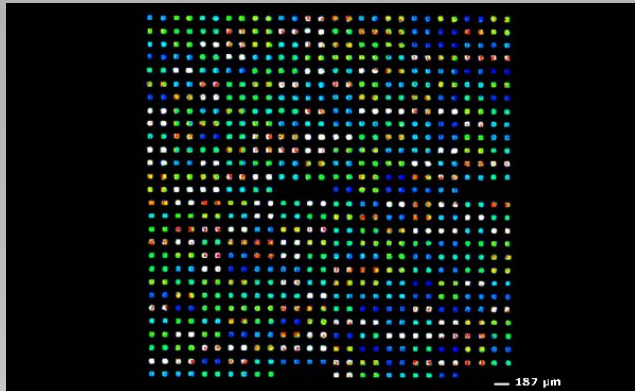


Implementation of genomic selection

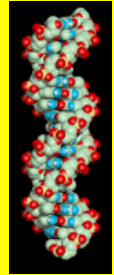
Genomic selection

1. Determine the best *DNA signature* for the production system under investigation
 - Require the DNA signatures and accurate estimates of genetic merit for many thousands of animals
2. Take a hair/blood/tissue sample a young animal
3. Send off to a laboratory to determine its DNA signature
4. Compare the DNA signature of the animal to the *best* DNA signature for Ireland





Laboratory DNA extraction & genotyping



ICBF

Group	Num of Cows	M Kg F Kg P Kg	F % P %	Surv% CI Days	Milk Solids % Contrib	Fertility % Contrib	Calving % Contrib	Beef % Contrib	Health % Contrib	EBI
Overall Cows	81	158 7.8 7.0	0.03 -0.1 0.04	-0.1 -0.3	€ 44 70.8% 4.4%	€ 2.7 24.8% 0%	€ 15.4 -7.4 0%	€ -1.7 0%	€ 53	
1st Lactation	16	167 7.7 7.4	0.03 -0.2 0.04	-0.2 -0.4	€ 45.8 69.4% 3.8%	€ 2.5 26.8% 0%	€ 17.7 -7 0%	€ -1.6 0%	€ 57	
2nd Lactation	22	148 6.5 6.5	0.02 -0.4 0.03	-0.4 -0.4	€ 39.6 73.3% 0%	€ -0.4 26.7% 0%	€ 14.4 -8.4 0%	€ -1 0%	€ 44	
3rd Lactation	18	156 7.9 6.7	0.04 -0.5 0.03	0.7	€ 42.4 70% 0%	€ -14.6 30% 0%	€ 13.3 -9 0%	€ -0.8 0%	€ 31	
4th Lactation	10	126 8.0 5.9	0.06 0.0 0.03	-0.9	€ 30.2 61.4% 18%	€ 11.5 20.6% 0%	€ 13.1 -8.3 0%	€ -1.6 0%	€ 54	
5th Lactation (+)	15	189 9.4 8.5	0.05 0.9 0.04	-1.1	€ 53.6 56.6% 23.8%	€ 22.5 19.7% 0%	€ 18.6 -3.0 0%	€ -3.8 0%	€ 87	



Genomic selection in Ireland

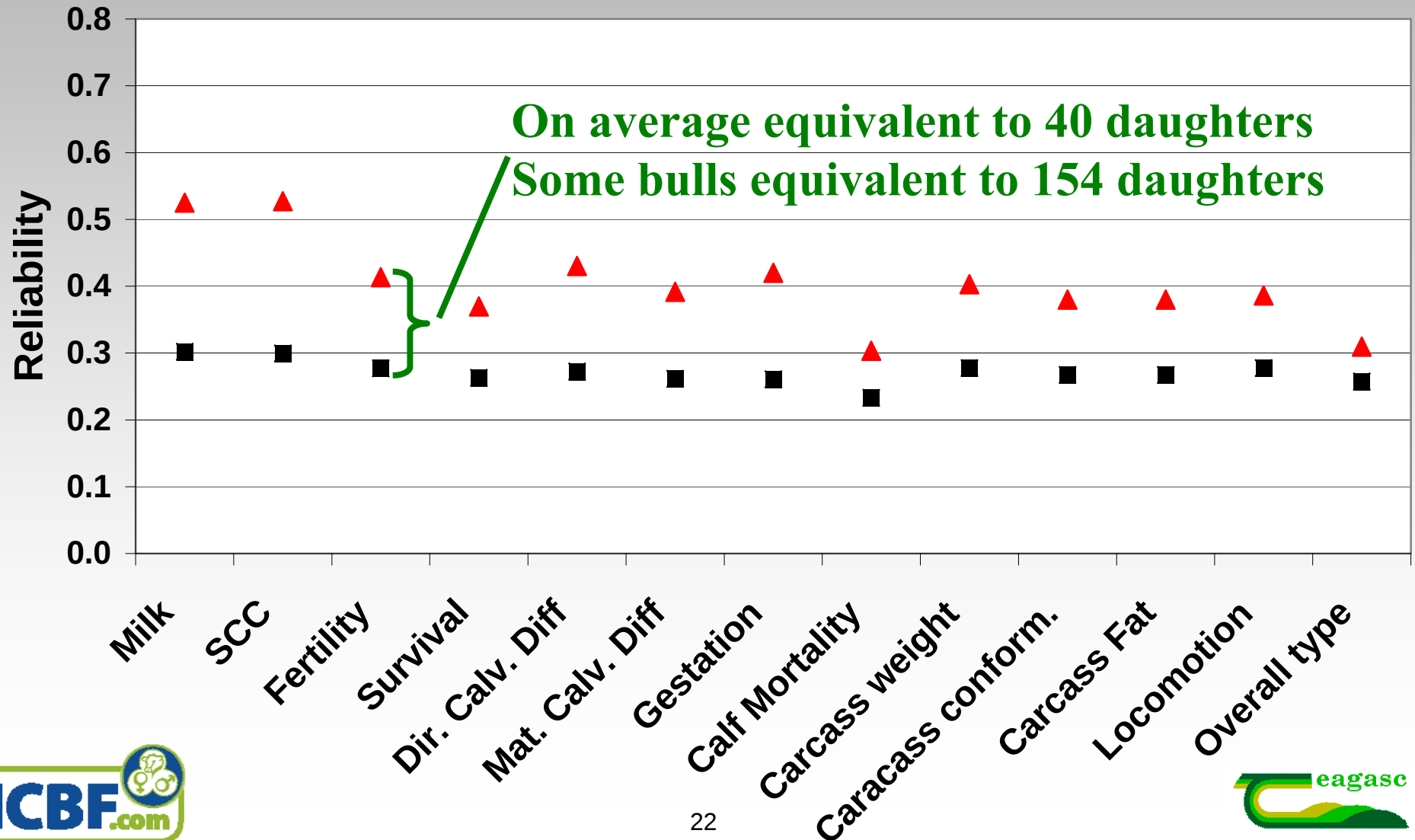
Dairying example

Training population

- 2009
 - 945 Holstein-Friesian AI bulls with progeny in Ireland
- 2010
 - Up to 3660 Holstein-Friesian AI bulls with INTERBULL evaluations
 - Extra genotypes obtained through swapping with LIC, Switzerland, Italy, UK, & Poland

Impact on reliability of young bulls

■ Parental average; ▲ Genomic



Uptake of genomic selection

- 462,000 inseminations from January to November 2009
- Three categories of bulls
 - DP-IRL: bulls with daughters producing in Ireland
 - DP-INT: bulls with daughters producing in some country
 - GS: genomically selected bulls with a calving survey

Proof	No. Bulls	Straws/bull	% Use	Bulls/Herd
DP-IRL	942	177	37	2.7
DP-INT	522	262	29	3
GS	98	1613	34	4

Why such an uptake?

- Mean difference between DP-IRL and GS bulls was €69 (more than one standard deviation better)
- Competitive pricing of GS bulls - range from €15-€18 euro
- AI companies marketed teams of bulls (high fertility, high protein, easy calving)
- Discount offered for buying bulls in teams

Preliminary results (n=35)

	Correlation		Bias	
	Parental average	Genomic	Parental average	Genomic
Milk yield	0.63	0.65	77	50
Fat yield	0.40	0.57	3.0	2.0
Protein yield	0.53	0.65	2.2	1.5

Genomic selection in Beef

What needs to happen?

Target

- Genomic selection available for Irish beef cattle in Spring 2011
- Simply won't happen without industry involvement
- Blood and semen is key to its success

Steps to achieving genomic selection in beef

- Need to have DNA from ~2,000 beef animals by October 2010
- Currently have DNA from ~350 bulls
 - 71 limousins
- AI bulls wanted are on ICBF website



Irish Cattle Breeding Federation

Striving to achieve the greatest possible genetic improvement in the national cattle herd for the benefit of Irish farmers, the dairy and beef industries and members. [Learn more about ICBF.](#)

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Genomic Selection - Beef

In order to benefit from the increased reliability of proofs that can be gained from using DNA profiles of animals we first need a large reference population of bulls with reliable genetic indexes. In order to increase this reference population we are looking for semen from these AI bulls which will then be genotyped. If you have any semen for these bulls that you would be willing to put forward for the purpose of beef genomics research please contact ICBF at aeu@icbf.com.

Genomic Selection

- [Beef](#)
- [Dairy](#)

Beef Bulls Wanted

Download Bull List: [excel](#)



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Steps to achieving genomic selection in beef

- AI bulls wanted are on ICBF website
 - Handout
- ICBF compiling list of stock bulls wanted
 - >25 progeny
- Greatest benefit is when back pedigree are also genotyped
- Foreign back pedigree

Steps to achieving genomic selection in beef

- Genotypes
 - ~€250 each
- Statistics
 - Moorepark
- Implementation
 - Everybody
- Optimal breeding program
 - Everybody

Role of limousin breed society

- Help in collecting semen/blood
- Funding
- Evaluate reorganisation of services?
 - Ear tag biopsy
 - Analysis for health status
 - DNA from ear sample for genotyping
 - Best bulls in Ireland and abroad identified, genotyped and marketed
- Breeding programs
 - Where are the best limousin dams in Ireland?

Conclusions

- Genomic selection is a tool to help in more accurately identifying genetic elite animals
- Genetic evaluation systems, breeding objectives and breeding programs are more important!!
- Genomic selection will change how we breed animals including breeding programs

Conclusions

We need DNA!!