

IRISH CATTLE BREEDING FEDERATION

Application of Genomic Selection in Dairy Cattle Francis Kearney ICBF, Donagh Berry Teagasc













AGRICULTURE AND FOOD DEVELOPMENT AUTHORITY

Background

- ~1.2 million dairy cows (and growing)
 - 95% Hol/Fr with small levels of crossbreeding
- Seasonal calving (90% calve in spring)
- Maximise use of grazed grass
- Calving dates optimised with turnout to grass
- A+B-C system of milk payments
- Fertility is essential
- EBI based on Bio-economic farm model developed by Teagasc - breeding index to deliver more profitable animals on farm



2014 Economic values and % emphasis for traits in the EBI				
Sub-Index	Trait	Economic Weight	Trait Emphasis	Overall Emphasis
	Milk	-€0.09	10.6%	
Production	Fat	€1.04	3.4%	33%
	Protein	€6.64	18.9%	
To add the s	Calving Interval	-€12.43	24.0%	250/
Fertility	Survival	€12.01	10.9%	the EBI Overall Emphasis 33% 35% 9% 9% 9% 7% 4% 3%
Calving	Direct Calving Difficulty	-€3.52	2.8%	
	Maternal Calving Difficulty	-€1.73	1.3%	
	Gestation Length	-€7.49	4.1%	9%
	Calf Mortality	-€2.58	1.0%	
Calving Beef Maintenance	Cull Cow Weight	€0.15	0.7%	
	Carcass Weight	€1.38	5.1%	
	Carcass Conformation	€10.32	1.7%	9%
	Carcase Fat	-€11.71	1.1%	
laintenance	Cull Cow Weight	-€1.65	7.2%	7%
	Milking Time	-€0.25	2.1%	49/
lanagement	Milking Temperament	€33.69	1.9%	4%
Health	Lameness	-€54.26	0.6%	
	SCC	-€43.49	1.8%	3%
	Mastitis	-€77.10	0.8%	



Genetic Trends in EBI





Genomic Selection

- National Genomic Evaluations introduced in Feb 2009 (2nd country in world after US)
- Revolutionised dairy cattle breeding globally
- Initially 1000 bulls in the reference population
- Reliability closely linked to the size of reference population
- Grown to 5000 through swapping with other countries primarily NZ, Aus, Poland, Switzerland, Belgium



Genomic Selection







Inseminations 2013

	% Use	No. bulls	Ave no.	Average EBI	EBI Rel
			buils used		
DP-INT	16	407	2.6	€204	58%
DP-IRL	24	754	1.9	€197	83%
GS	60	129	4.5	€259	55%

DP-INT – Daughter Proof with foreign daughters

DP-IRL – Daughter Proof with Irish daughters

GS – Genomically selected with no daughter

Similar trends seen in GS bull usage internationally



Results

• Average PTA (reliabilities in brackets)

	Genomic	Daughter	PA
Milk	108 (61)	116 (90)	168 (41)
Fat	10.2	10.4	11.9
Prot	7.7	7.8	9.6
CI	-3.7 (46)	-4.5 (71)	-3.1 (30)
SU	1.7	2.01	1.52
CD	1.9 (50)	2.7 (90)	3.05 (37)
Gest	-2.05	-2.7	-1.5
Carcase Weight	-3	-1.55	-1.39
Carcase Conf	-0.67	-0.64	-0.56



Results

· Expected difference among bulls – average MSI -€3





Results

 Expected difference among bulls – average diff FSI of €12 (daughter proof is greater than genomic proof)



Distribution of Differences - FSI



Next Generation Herd - Objective Genetically elite and diverse research herd

- 1. Breeding cows compatible to Irish grass based production system
- 2. To facilitate the monitoring of difficult to measure traits
 - Cow health, greenhouse gas emissions, intake
 - Deleterious consequences of genetic selection?
- 3. To enhance the development of the EBI
 - Identify new traits



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Genetic Potential

	Elite (n=90)	Average (n=45)
EBI	244	133
Milk SI	67	48
Fertility SI	169	63
Calving SI	35	28
Beef SI	-12	-9
Maintenance SI	13	4
Health SI	0	0
Management SI	2	0

Mature equivalents . . .

	National Avg			Elite		
21/09/2014	CON	LGA	HC	CON	LGA	HC
Milk yield	4611	4247	5502	4671	4434	5315
Fat (%)	4.20	4.17	4.10	4.55	4.57	4.36
Protein (%)	3.46	3.43	3.52	3.61	3.61	3.72
Milk solids	353	323	419	381	363	429
Cumulative MS yield	365 (kg/cow)		391	(kg/co	w)	



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Fertility to date . . .

	Average	Elite
3 wk submission rate (%)	82	92
6 wk in-calf rate (%)	60	77
12 wk in-calf rate (%)	78	95



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Genomics On Farm

- Use of genomics on farm for management decisions is increasing
- Selecting replacement heifers
- Parentage identification especially in larger herds
- Better management of inbreeding and genetic defects



Genomics on-farm





Future Plans

- Continue to increase the size of reference population
- Continue to validate genomic selection
- Work towards multi-breed genomic evaluations
- Genomics will play a crucial role in introduction on new, hard to measure traits such as feed intake, health & disease
- Genomic matings precision matings based on SNP effects of cow to bulls to create best offspring
- Breeding programme will evolve
- Collection of data is even more crucial with genomics!

