Dr. Kath Donoghue

Dr. Kath Donoghue is a Beef Cattle Geneticist at the Animal Genetics and Breeding Unit, Armidale. Kath comes from a rural background, growing up on her family's property near Coolah, NSW, and having had close association with her family's Toolangatta Hereford stud operations for many years. She also has a small registered Hereford herd of her own. After completing undergraduate studies at UNE and two years as a research assistant at AGBU, Kath was the recipient of a Junior Research Fellowship from MLA to attend the University of Georgia (UGA), Athens, USA. During her time at UGA, she completed her Masters and PhD degrees in Animal Breeding and Genetics. Kath's research at AGBU includes investigation of an international genetic evaluation for Limousin and Charolais breeds using data from Australia, New Zealand, Europe, and USA. Kath also conducts research for international clients of ABRI, which include Hereford and Saler Breed Associations in USA and Canada.

WORLD HEREFORD GENETIC LINKAGE PROJECT OUTCOMES

Introduction

The main goal of the World Hereford Genetic Linkage Project was to generate genetic linkages across countries to gain a better understanding of how Hereford genetics performs in different environments and on different continents. The project was designed to establish genetic linkages between North America and Australia that could be further developed during the coming years. Four sires from each continent (two polled and two horned) were used to generate progeny in Australia and North America. Performance records on growth and scan traits were collected on all World Hereford progeny born in Australia, and submitted to BREEDPLAN. Additionally, temperament, feed efficiency and carcase data were collected for Australian steer progeny. The latest Australian Hereford BREEDPLAN EBVs for the eight sires will be available at the conference, and include all available data from Australian World Hereford progeny. Progeny born in North America have performance data for early growth traits recorded to date, and this will be included in future North American genetic evaluations, with updated EPDs available for all eight sires available at a later date.

Materials and Methods

Eight sires were used to generate 608 World Hereford progeny in Australia and North America. These sires were mated to commercial females in four Australian herds (Branga Plains, Keswick, Parraweena and Yalgoo), two Canadian herds (Copper Creek and Hanson Ranches) and one herd located in the US (Olsen Ranch). The progeny numbers generated for each sire in Australia, US and Canada are presented in Table 1, as well as number of steer progeny born in Australia sent to Tullimba Research feedlot.

Table 1. World Hereford Linkage Project progeny numbers in Australia (AUS), Canada (CAN) and US

Sire	Progeny born in AUS		Progeny born in US	Progeny born in CAN
	Total	Feedlot steers		
Remitall Governor 236G	29	14	38	16
Feltons Endurance 745	25	8	30	13

Jet Domino L617	33 10	30	15
MHF X160 Reform 77H	24 8	39	15
Yarram Hot Shot P028	25 11	37	15
Injemira Advance U118	23 11	40	12
Heatherdale Opium U78	23 8	31	13
Mount Difficult Unsworth U86	25 8	36	21

The Australian World Hereford progeny (both steers and heifers) were raised on the four properties, with birth, weaning and yearling weight and scan data recorded. Steer progeny from Branga Plains, Keswick and Yalgoo (n = 78) were transferred to Tullimba Research feedlot at approximately 470 days of age, while female progeny were retained on-property. Data collected on steers included feed efficiency data from a 70-day feed intake trial, weekly weights, flight time (a temperament measure) and exit ultrasound scan records. Abattoir carcase data was collected post-slaughter. Data on maternal traits from the retained heifers is expected in the future.

The North American World Hereford progeny were raised on the three ranches, with birth and weaning weight data recorded to date. Yearling weight data has been recorded at Copper Creek Ranch, and is expected to be recorded in the near future at the other locations. Records for the following traits will also be recorded in the future; yearling scan data, abattoir carcase data and maternal traits. More detailed information regarding traits recorded in Australia and North America can be found in Table 2.

Table 2. Traits recorded for World Hereford progeny in Australia (AUS), Canada (CAN) and US

Trait	**AUS**	**US**	**CAN**
Birth weight	✓	✓	✓
Weaning weight	✓	✓	✓
Yearling weight	✓	(✓)	✓
Yearling Scan traits:			
- EMA/REA	✓	(✓)	(✓)
- Rib & Rump fat	✓	(✓)	(✓)
- Intramuscular fat percent (IMF%)	✓	(✓)	(✓)
600 day wt	✓		
Temperament/Meat Quality:			
- Flight Time	✓		
Feed Efficiency:			
- Net Feed Intake	✓		
- IGF-I	✓		
Carcase traits:			
- Carcase weight	✓	(✓)	(✓)
- EMA/REA	✓	(✓)	(✓)
- Rib & Rump fat	✓	(✓)	(✓)
- Marble Score/Grade	✓	(✓)	(✓)
Maternal traits	(✓)	(✓)	(✓)

✓ = Trait information available
(✓) = Trait information expected to be recorded in future

Some traits recorded in Australia are relatively new, and some breeders may not be familiar with them. A brief summary of net feed intake (NFI), insulin-like growth factor (IGF-I) and flight time (FT) follows. Further detailed information on these traits can be found at the BREEDPLAN website (http://breedplan.une.edu.au).

The feed efficiency measure, NFI, is the amount an animal eats, under or over, that expected for its weight and gain. This measure has the important benefit of being independent of the animal's weight and gain. The data presented in this paper are progeny averages, and are based on the feed intake and weight gains of the progeny group for the duration of the test. NFI EBVs are reported as kilograms (kg) of

feed eaten per day, and the more negative the EBV, the less feed eaten and the more efficient the animal. NFI is relatively expensive to measure, due to the large costs associated with running a feed intake trial. The blood protein IGF-I measured at weaning has been found to be moderately heritable and is genetically correlated with NFI. Data from blood tests for IGF-I can be obtained at a much lower cost in comparison to feed efficiency trials, and are now accepted into BREEDPLAN.

Flight time is an indirect measure of temperament, and is based on the time an animal takes to move a specified distance after exit from a crush/chute. A significant genetic relationship between temperament and meat quality has been estimated using Beef CRC data in tropically adapted breeds; animals with larger FT (i.e. slower exit, and therefore quieter temperament) will, genetically, have more tender meat. This trait is simple to record, and data is being collected in seedstock herds that will allow the development of a FT EBV.

Results

All performance data recorded to date for the Australian progeny has been submitted to BREEDPLAN, and included in the March 2004 genetic evaluation. The latest Australian Hereford BREEDPLAN EBVs for the sires from this analysis will be available at the World Hereford Conference. Performance data from the World Hereford progeny born in North America will be submitted for inclusion in future North American Hereford genetic evaluations, with updated EPDs available at a later date.

1) Across Country

Records for the early growth traits of birth, weaning and yearling weight have been collected in Australia, US and Canada, and a summary of this information can be found in Table 3. Adjusted birth (BWT), weaning (WWT) and yearling (YWT) weight progeny averages for the two groups of sires (Australian and North American sires) are presented for each country. Data were adjusted using standard BREEDPLAN (progeny born in Australia) and North American Hereford (progeny born in US/Canada) adjustments for the particular trait (all traits: age of dam; WWT and YWT: age of animal). The average adjusted BWT of progeny born in Australia was similar for sires of Australian (37 kg) and North American (36 kg) origin, and a similar result was observed for progeny born in US and Canada. The trend of similar progeny averages for the two sire groups within a country was also evident for adjusted WWT and adjusted YWT. These results indicate that, on average, rankings for both groups of sires were similar across each of the three countries. These data will be combined with existing genetic links between the three countries. The breeding values of the World Hereford Link Sires will be used in conjunction with these genetic links to formally estimate the genotype by country interaction and investigate the most appropriate approach for an international Hereford genetic evaluation. At this stage results from this project would indicate little evidence of such an interaction for early growth traits.

Table 3. Mean progeny performance for Australian (A sires) and North American (N sires) sires for adjusted birth, adjusted weaning and adjusted yearling weight in Australia, US and Canada

Trait	**Progeny born in AUS**		**Progeny born in US**		***Progeny born in CAN***	
	A sires	***N sires***	**A sires**	**N sires**	**A sires**	**N sires**
BWT (kg)	37	36	38	38	43	42
WWT (kg)	197	199	222	223	232	225
YWT (kg)	354	354	-	-	415	417

2) Within Australia

Records for yearling scan traits, 600-day weight, feed intake and carcase data are currently only available for World Hereford progeny born in Australia. These results, along with the breeding values of the sires, will be used to investigate genotype by country interactions and combined evaluations when data from North America is available for these traits. The progeny averages presented below, particularly for traits measured only on steers, are based on relatively small numbers of progeny born in Australia, as shown in Table 1, and should be interpreted with caution. The latest Australian Hereford BREEDPLAN EBVs will be available at the World Hereford Conference for many of these traits. These EBVs, which include data from progeny born in Australia, and account for all pedigree and performance information, provide a more accurate estimate of the genetic differences between the sires.

All Australian World Hereford progeny (both steers and heifers) were scanned as yearlings and recorded a 600-day weight, and progeny means for each sire can be found in Table 4. Data were adjusted using

standard BREEDPLAN adjustments for age of animal and age of dam for the particular trait. Some variation was observed between sires for adjusted scan rib fat (range: 1.5 mm), adjusted scan eye muscle area (range: 3.8 cm^2) and adjusted scan IMF (range: 1.1 %). Some variation was also observed between sires for adjusted 600-day weight (range: 39 kg).

Table 4. Mean progeny performance for adjusted scan rib fat, adjusted scan eye muscle area (EMA), adjusted scan intramuscular fat percentage (IMF%) and adjusted 600-day weight

Sire ID	Scan rib fat (mm)	Scan EMA (cm^2)	Scan IMF(%)	600-day wt (kg)
N1	6.7	65.2	5.1	515
N2	7.9	65.8	5.5	510
N3	6.7	65.1	4.8	531
N4	6.4	66.2	5.1	522
A1	6.6	65.5	5.3	516
A2	6.8	63.7	4.9	506
A3	7.2	64.8	5.5	492
A4	7.0	67.5	4.4	523
Average	6.9	65.5	5.1	514

Progeny means by sire for the Australian steer progeny are summarised in Table 5 for average daily gain (ADG) for the feed intake test period, daily feed intake (DFI), NFI and FT. Some variation was observed between sires for the traits; ADG (range: 0.33 kg/day), DFI (range: 1.8 kg/day), NFI: (0.95 kg/day) and FT (range: 0.5 sec). In addition to these progeny averages, Australian EBVs for NFI, which includes the feed efficiency test data, will be available at the World Hereford Conference for these sires.

Table 5. Mean progeny performance for average daily gain (ADG), daily (DFI) and net feed intake (NFI), insulin-like growth factor (IGF-I) and flight time (FT)

Sire ID	ADG (kg/day)	DFI (kg/day)	NFI (kg/day)	FT (seconds)
N1	0.95	12.7	0.18	1.0
N2	1.08	12.8	0.26	1.4
N3	1.14	13.4	-0.10	1.0
N4	1.01	13.2	0.55	1.2
A1	1.02	12.5	-0.09	1.2
A2	0.81	12.3	0.15	1.1
A3	0.91	11.6	-0.40	0.9
A4	0.92	12.6	-0.15	0.9
Average	0.98	12.6	0.05	1.1

Progeny means for abattoir carcase traits for the steer progeny are summarised in Table 7. Traits recorded include adjusted carcase weight (CWT), adjusted carcase rib fat (CRF), adjusted carcase eye muscle area (CEMA) and carcase marble score (CMS). Carcase weight data were adjusted for age of animal, while CRF and CEMA were adjusted to a 300 kg carcase endpoint. Some variation was observed between sires for the traits; CWT (range: 40 kg), CRF (range: 3.5 mm), CEMA (range: 3.8 cm^2) and CMS (range: 1.4 scores).

One of the goals of this project was to create useful genetic links between Australia and North America to assist in the possible development of an international Hereford genetic evaluation. In this project, all sires had a large effective number of progeny, relative to that observed in field data. The effective number of progeny depends on the number of progeny from the sire in a contemporary group, as well as the number of progeny from other sires to which they can be compared. Sires whose progeny belong to

contemporary groups with many sires represented will have a higher effective number of progeny than sires whose progeny belong to contemporary groups with only a few sires represented. As nearly all contemporary groups in this project contained progeny from all 8 sires, the average effective number of progeny per sire as percent of total progeny in this project (ranging from 80 to 90%) are much higher than we would normally observe in beef field data. Therefore records from this progeny test are more valuable then field records when developing an international genetic evaluation.

Table 7. Mean progeny performance for abattoir adjusted carcase weight (CWT), adjusted carcase rib fat (CRF), adjusted carcase eye muscle area (CEMA) and carcase marble score (CMS)

Sire ID	**CWT (kg)**	**CRF (mm)**	**CEMA (cm^2)**	**CMS**
N1	353	8.0	73.1	1.0
N2	345	10.9	75.3	1.6
N3	370	9.2	73.7	0.6
N4	356	8.9	76.4	1.8
A1	370	7.9	74.1	0.7
A2	330	9.0	75.4	0.7
A3	335	8.4	76.9	0.9
A4	355	7.4	75.0	0.4
Average	352	8.7	75.0	1.0

Conclusions

The results presented for early growth traits indicate little differences in the average performance of the progeny of Australian and North American sires in any of the three countries. Carcase data (both ultrasound and abattoir) progeny averages tend to indicate some differences between top and bottom ranking sires, although these differences are small for the majority of traits. The latest Australian BREEDPLAN EBVs, which will include this information, as well as account for pedigree information, will provide a more accurate estimate of the genetic differences between sires. Obtaining data for as many traits as possible in North America will provide progeny averages and rankings for the same sires in that environment. This data can then be pooled with data from Australian World Hereford progeny, along with data from other existing genetic links, to formally estimate the genotype by country interaction and investigate the most appropriate approach for an international genetic evaluation for growth and carcase traits for the Hereford breed.