The Brahman Project

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Introduction

The subtropical environmental conditions of the southern region of the U.S. present severe challenges to the survival, reproduction, and growth performance of beef cattle. Because of its superior adaptability to hot and humid conditions, Brahman cattle are widely used to produce crossbred animals with good reproductive and growth characteristics that exhibit substantial levels of heterosis. Brahman cattle have good postweaning feed efficiency, but carcass and meat palatability characteristics need improvement to be competitive with *Bos taurus* breeds. Thus, there was a need for a research project that combined the efforts of ranchers and researchers with a goal of improving Brahman genetics for reproduction, growth, feed efficiency, and carcass and meat palatability characteristics. These objectives were at the core of a series of meetings that took place in Brooksville at the end of 2009 and beginning of 2010 whose outcome was the Brahman project. The first meeting occurred in November of 2009 and it was attended by Florida cattlemen, University of Florida (UF) faculty and administrators, and USDA-Agricultural Research Service (USDA-ARS) scientists and administrators. This meeting was followed by three meetings between animal breeding faculty from UF, ARS scientists from Brooksville, and invited scientists from Texas A&M, New Mexico State University, Louisiana State University, and the USDA-Meat Animal Research Center. These meetings produced a document specifying specific plans for the Brahman project. The central idea from these meetings was the construction of a large Brahman herd that would be housed in Brooksville and it would have ties to multiple private and experimental herds in Florida and the Southern region. The Brooksville herd and cooperating herds would result in a large connected population representative of the Brahman population in Florida and the Southern region, allow for improved selection efforts for reproduction, growth, feed efficiency, carcass, and meat quality traits, and have a positive impact in the Brahman population through the dissemination of genetic material from animals with superior genetic predictions.

Objectives

The objectives of the Brahman project are: 1) To develop a Brahman population that includes animals from various subpopulations to conduct genetics and genomics evaluation and selection for reproduction [e.g., age at puberty, stayability (cows with 3 or more consecutive calves)], growth (preweaning and postweaning), feed efficiency, ultrasound, and carcass and meat palatability traits (e.g., ribeye area, marbling, tenderness); 2) To construct a database with pedigree, genomic, and phenotypic information (reproduction, growth, ultrasound, carcass traits as available) from all participating herds; 3) To conduct genetic and genomic evaluation of animals in the population for reproduction, growth, feed efficiency, ultrasound, and carcass and meat palatability traits using pedigree, genomic, and phenotypic information; and 4) To identify and disseminate genetics from animals with the best predicted genetic and genomic values for reproduction, growth, feed efficiency, and carcass and meat palatability traits in the research Brahman population and elsewhere.

Population Structure

The population (Figure 1) will be formed by a group of connected experiment station and private Brahman herds from Florida (Brooksville, private herds), Texas (contributing

experimental stations, private herds), Louisiana (contributing experimental stations, private herds), and other states in the Southern region, and herds with purebred and crossbred Brahman cattle (including the UF Angus-Brahman multibreed herd). We are currently at the stage of constructing the Brahman herd at Brooksville and in the process of establishing working relationships with experimental stations and private producers. Starting this year (2012), the organization responsible for the Brooksville station will change from the USDA-ARS to UF.

Herds will be genetically connected by using several common sires across herds each year. These sires will create geographic and time connections needed to conduct genetic and genomic evaluation of all animals from all participating herds using information from all years. Arrows in Figure 1 indicate genetic connectedness created across herds through common sires and dams. Connectedness would be accomplished by semen, embryo transfer (ET), and in-vitro fertilization (IVF) for sires, and by ET and IVF for cows. Although during the initial years of the construction of the foundation Brahman herd in Brooksville most of the connectedness would occur from contributing herds towards Brooksville, this is expected to change after the Brooksville herd is established. Thus, connections among all cooperating herds are expected to increase in the future. Table 1 shows the list of sires used for ET and IVF during the first two years of this project (2010 to 2011). Of the 20 sires used in Table 1, four of them were used in 2010 and 2011, and four sires used in 2011 are planned to be used again in 2013. Table 2 contains the list of natural service (NS) sires used in Brooksville from 2009 to 2012. One common NS sire was used in 2009 and 2010, and another one in 2011 and 2012 creating connections among these years. Thus, at this stage the Brahman population formed by the Brooksville and cooperating herds is currently well connected across herds and years.

The foundation Brahman herd in Brooksville is currently intended to have 500 cows. This number of cows may need to be revised in future years depending on the carrying capacity of the Brooksville station and funding resources. It will be composed of females from the Brahman herd in 2010, females donated or purchased from other herds (experiment stations, private herds), and animals produced by embryo transfer (ET cows) and in-vitro fertilization (IVF cows). Table 3 shows the current status of the Brooksville Brahman herd by herd of origin and age of female (cows, two-year olds, yearling, and calves) produced by natural service (NS), ET, and IVF. There are 75 adult cows (65 originating from Brooksville and 10 from Overton, TX), 11 two-year olds, 26 yearlings from Brooksville (NS and ET) and three cooperating herds from Florida (ET), and 54 heifer calves from Brooksville (NS and ET) and five cooperating herds from Florida and Texas. Table 4 shows the number of donor cows producing heifer calves in 2010, and heifer and bull calves (in parenthesis) in 2011. Donor cows that were used for ET matings, during these years also contributed to connectedness among herds.

The procedure currently used by Brahman producers to contribute to the Brooksville herd has followed an outline specified in 2010. This outline suggested donations, purchases and temporary transfer of cows that had shown desirable characteristics of early maturity and consistent fertility for at least the first three calvings. Currently, genetic material from at least 14 herds of origin is represented in the Brooksville herd. Considering the current numbers of cows, two-year olds, yearlings, and calves in 2012 and all forms of reproduction (AI, NS, ET, and IVF), it would take at least five years to construct a herd of 500 adult cows in Brooksville (i.e., 2012 to 2016). To achieve this goal, Brahman breeders would need to continue to contribute with females, embryos, and (or) ova for IVF during the establishment period of the Brooksville herd, and in subsequent years as needed. To obtain a representative sample of the Brahman population in the Southern region, a proportional representation from each cooperating private herd in the foundation herd could be pursued. However, because this may be difficult to achieve, a more realistic goal would be to establish a good degree of connectedness among cooperating herds and

Brooksville by appropriate representation of sires and dams across herds and across years. Because 2012 is a transitional year, the mating plan for Brooksville will only use natural service (Table 5).

Data and Tissue Sample Collection and Storage
A complete pedigree file with information on all animals in the population will need to be maintained. This file would include information of all calves, sires, and dams present in all cooperating experimental and private herds.

Phenotypic data to be collected include: a) reproduction (e.g., age at puberty, calving interval), growth (weights at birth, weaning, yearling, post-yearling weights; cow weights), temperament, and ultrasound data (area of the longissimus muscle, marbling, backfat thickness); b) feed efficiency data; c) carcass and meat palatability data (carcass weight, area of the longissimus muscle, marbling, backfat thickness, shear force, tenderness, connective tissue, juiciness, flavor, off-flavor). Phenotypes would be collected in the Brahman herd at Brooksville, the UF Angus-Brahman multibreed herd, contributing experimental stations, and private herds. Phenotypes that are an integral part of herd management will likely be collected at all locations (e.g., health data, calving dates, weights), *whereas available funding will be a determining factor for the collection of other phenotypes (e.g., feed efficiency, carcass, and meat palatability traits)*. Thus, a realistic objective will be to collect data on as many traits as possible at each location.

Tissues to be sampled would be semen (4 straws) or blood (10 cc) from sires and blood (10 cc) from females and calves. It would be desirable to collect tissue samples from the Brooksville herd, the UF Angus-Brahman multibreed herd, and all cooperating experimental and private herds. At least all bulls used in the population should be sampled (four straws of semen or 10cc of blood). These samples will need to be maintained in a repository for long-term storage and retrieval (e.g., ICBR at the University of Florida, or other suitable reliable site). ***Provided that funding is***

available, a genomic analysis of tissue samples would be conducted prior to performing a genetic-genomic evaluation of animals in the population using chips of suitable density ***depending on amount of funding and cost at the time of analyses*** (e.g., Illumina 50K, 770K, other).

A flexible database structure for records collected in Brooksville, the UF Angus-Brahman multibreed herd, and cooperating experimental stations and private herds will need to be established. As indicated above, information collected at each location need not necessarily be the same, but there would need to be traits in common to be able to conduct joint analyses for the complete population. Data would need to be forwarded and stored at a central location (e.g., Brooksville or UF). Computer software used for this purpose would need to be simple and flexible. Initially, spreadsheet files (e.g., Microsoft Excel) will suffice. Later on, a database system with dedicated computer programs for data access through the internet could be implemented so that producers could enter and manage data from individual herds. This implies the construction of a homepage for this project. At least one computer technician would need to be hired to accomplish these tasks (programming, database entry and maintenance, data analysis).

Genetic and Genomic Evaluation
Animals will be genetically evaluated for reproduction, growth, feed efficiency, ultrasound, and carcass and meat palatability traits using pedigree, phenotypic and genomic information. After the foundation population is established, genetic and genomic predictions for these traits could be used to construct indexes that emphasize: a) primarily reproduction and growth traits, and secondarily carcass traits, and 2) primarily carcass and growth traits, and secondarily reproduction traits. Selecting animals based on these indexes will effectively create two selection lines within the Brahman herd. These indexes would need to be further discussed with cooperators in the Brahman project.

Culling, Mating, and Selection
Females will be culled for health, reproduction, and production issues as in any commercial cow-calf operation. Heifers will be given two opportunities to get pregnant (spring at 2-years of age and spring at 3-years of age). Heifers not pregnant at 3-years of age will be culled. Cows will be culled after failing to become pregnant or to wean a calf in two consecutive breeding seasons.

Cows will be mated by artificial insemination and subsequently placed in groups of 35 to 40 cows with a natural service sire for a period of 60 days. Mating will be designed such that inbreeding is minimized. To maintain connectedness across years, a fraction of the sires used in a given year (e.g., 25%) sires will be used for a second year. Similarly, sires used at Brooksville will also be represented in the UF Angus-Brahman multibreed herd and cooperating experimental and private herds, and vice versa. This will create connectedness across herds and across years among all participating herds in the project and permit the evaluation of all animals in the population.

Bulls and cows could be selected using the indexes outlined above. Again, further discussion on these selection indexes is warranted. Animals in line 1 would be selected based on an index that emphasized primarily reproduction and growth, and secondarily carcass, whereas animals in line 2 would be selected based on an index that emphasized primarily carcass and growth, and secondarily reproduction. Traits included in these indexes and weight for each trait would need to be researched using information from the foundation Brahman herd in Brooksville.

Bulls could be evaluated for age at puberty by postweaning monthly breeding soundness evaluations, including measurement of scrotal circumference and semen sperm count (50 million sperm/ml and 10% motility minimum). In addition, if feed efficiency measurements were taken for each calf crop every year, young bulls could also be evaluated after finishing the feed efficiency trial as follows: a) Line 1: based on an index that has higher weight for reproductive information of their female relatives (dam and collaterals, and older relatives), and lower weight for carcass information (relatives), ultrasound information (animal and relatives), and growth (animal and relatives; pre and postweaning growth); and b) Line 2: based on an index that gives higher weight for carcass (relatives) and ultrasound information (animal and relatives), and lower weight to reproductive information of their female relatives (dam and collaterals, and older relatives), and growth (animal and relatives; pre and postweaning growth).

Heifers could be evaluated when they are 3-years of age, after testing for pregnancy, using the same indexes used for males for lines 1 and 2, except that their own reproductive information would also be taken into account. During the initial period of formation of the Brooksville Brahman herd, indexes based on phenotypic information could be used to choose replacement animals instead of indexes based on predicted breeding values.

Assessment of Genetic Change
Genetic change over time for individual traits or indexes in the Brahman Brooksville herd, other individual herds and for the complete Brahman population could be assessed by using weighted and unweighted herd means for calves, sires, and dams. Yearly means per selection line could also be compared within years and with respect to the foundation Brahman herd in Brooksville.

Data Analysis
Prior to any data analysis in the Brahman project, pedigree and phenotypic information from all animals in the Brooksville foundation herd, the UF Angus-Brahman multibreed herd, and cooperating experimental and private herds needs to be collected and merged into a single set of files for genetic and genomic analyses. These files will be used to conduct analyses of research and development interest including (phenotypic and genomic data permitting): 1) determination of factors to be included in contemporary groups for reproduction, growth, feed efficiency, ultrasound, and carcass and meat palatability traits; 2) comparison of groups of animals produced by all reproductive systems

used to create the Brooksville Brahman herd (AI, NS, ET, and IVF) for growth, reproduction, and carcass traits (as available); 3) comparison of groups of Brahman cattle in Brooksville from different geographical origin for reproduction, growth, feed efficiency, and carcass and meat palatability traits (as available); 4) prediction of genetic and genomic values and estimation of genetic and genomic parameters for reproduction, growth, feed efficiency, ultrasound, and carcass and meat palatability traits; 5) comparison of groups of Brahman cattle by geographical origin using means of predicted genetic and genomic values.

Expected Outcomes

Genetic and genomic evaluation of animals from all cooperating herds in the population. Within-herd and across-herd ranking of animals by their genetic and genomic expected breeding value for reproduction, growth, feed efficiency, ultrasound, and carcass and meat palatability traits. Improvement of these traits within herds and in the complete Brahman population by preferential use of animals with superior expected breeding value as parents of subsequent generations (reduction of cow losses due to fertility and stayability problems, faster growth rates, improved feed efficiency, and increased tenderness and marbling). Determination of genetic trends for males and les over time for all traits and comparisons of Brahman cattle grouped by various criteria (e.g., selection lines, geographic origin). *It should be emphasized that availability of funding for the collection of some phenotypes (e.g., feed efficiency, carcass and meat palatability traits) and for genomic analysis with high density chips (e.g., Illumina 50K and 770K) will determine if these aims of the Brahman project will be accomplished.*

Table 1. Sires used in Brooksville for embryo transfer or in-vitro fertilization sires (2010 to 2012)

Year	Sire Reg #	Sire Name	Herd of Origin	State
2010	794506	REP SIR MANSO MANGUM 420	DOC PARTIN RANCH	FL
2010	306428	+BL LITTLE BOZO 1/8	BERCHMAN LAVERGNE	LA
2010	800995	JDH MR MANSO 236/3	J.D. HUDGINS-FORGASON DIV.	TX
2010	854694	MR TAES 6087	TEXAS A & M UNIVERSITY	TX
2010	863297	MR TAES 7145	TEXAS A & M UNIVERSITY	TX
2011	794506	REP SIR MANSO MANGUM 420	DOC PARTIN RANCH	FL
2011	804549	KCC SUTTON DUBO 135	KEMPFER CATTLE COMPANY	FL
2011	832506	KCC EMPEROR DUBO	KEMPFER CATTLE COMPANY	FL
2011	306428	+BL LITTLE BOZO 1/8	BERCHMAN LAVERGNE	LA
2011	877366	SCD DIDOR ESTO 623	D BAR RANCH	LA
2011	845544	NMSU 6X CLOVERDALE 5129	NEW MEXICO STATE UNIVERSITY	NM
2011	862754	NMSU GARRETT MANSO 7057	NEW MEXICO STATE UNIVERSITY	NM
2011	295806	JDH MULHIM EMP MANSO	J.D. HUDGINS-LOCKE DIV.	TX
2011	800995	JDH MR MANSO 236/3	J.D. HUDGINS-FORGASON DIV.	TX
2011	829894	MR TAES 3040	TEXAS A & M UNIVERSITY	TX
2011	851136	MSP SPECIAL RELOAD 945	PARTIN & PARTIN HEART BAR RANCH	TX
2011	863297	MR TAES 7145	TEXAS A & M UNIVERSITY	TX
2013	783104	REP IMPRA MANGUM 370	UF MULTIBREED HERD	FL
2013	804549	KCC SUTTON DUBO 135	KEMPFER CATTLE COMPANY	FL
2013	816797	REP WALTER MANSO	UF MULTIBREED HERD	FL
2013	778115	MR.SUNLAND 6X 874	NEW MEXICO STATE UNIVERSITY	NM
2013	845544	NMSU 6X CLOVERDALE 5129	NEW MEXICO STATE UNIVERSITY	NM
2013	871628	NMSU DUBO CHERRA 45/1	NEW MEXICO STATE UNIVERSITY	NM
2013	586630	EJL EMPER SUVILLE 176	SANTERLAND RANCH LTD. CO.	TX
2013	809856	MSP ESTO CHERRA 754	PARTIN & PARTIN HEART BAR RANCH	TX
2013	851136	MSP SPECIAL RELOAD 945	PARTIN & PARTIN HEART BAR RANCH	TX
2013	862754	NMSU GARRETT MANSO 7057	NEW MEXICO STATE UNIVERSITY	NM

Table 2. Natural service sires used in Brooksville from 2009 to 2012

Year	Sire Reg #	Sire Name	Herd of Origin	State
2009	857614	BB MR WEST BERCH 508	BARTHLE BROTHERS RANCH	FL
2009	842143	STARS 03-048	STARS	FL
2009	856461	TH BURMA BEN 182-04	TREASURE HAMMOCK RANCH	FL
2010	856461	TH BURMA BEN 182-04	TREASURE HAMMOCK RANCH	FL
2010	828050	JCC DAK Charley 109/1	DOUBLE C BAR RANCH	FL
2011	863297	MR TAES 7145	TEXAS A & M UNIVERSITY	TX
2011	894378	STARS 09-212	STARS	FL
2012	863297	MR TAES 7145	TEXAS A & M UNIVERSITY	TX
2012	890628	MR. TAES 0107	TEXAS A & M UNIVERSITY	TX
2012	864628	KCC 272 OF 185-176	KEMPFER CATTLE COMPANY	FL

Table 3. Numbers of Brahman females by herd of origin and age

Herd of origin	Repro System	Cows	2-Year Olds	Yearlings	Calves	Total
Brooksville	NS	65	11	7	27	110
Texas AgriLife	NS	10				10
Barthle Bros Ranch	ET				4	4
Brooksville	ET			8	4	12
Doc Partin Ranch	ET			9	7	16
Kempfer Ranch	ET			2		2
Texas AgriLife	ET				12	12
Total		75	11	26	54	166

Table 4. Numbers of donor Brahman cows producing heifers by herd of origin and year of mating[1]

Herd of origin	2010	2011
Barthle Bros Ranch		3 (4)
Brooksville	3	2 (5)
Doc Partin Ranch	3	3 (4)
Kempfer Ranch	1	
Texas AgriLife		8 (9)
Gray Shadow Ranch		0 (3)
Total	7	16 (25)

[1]Total number of donor cows in parenthesis

Table 5. Natural Service Matings for 2012

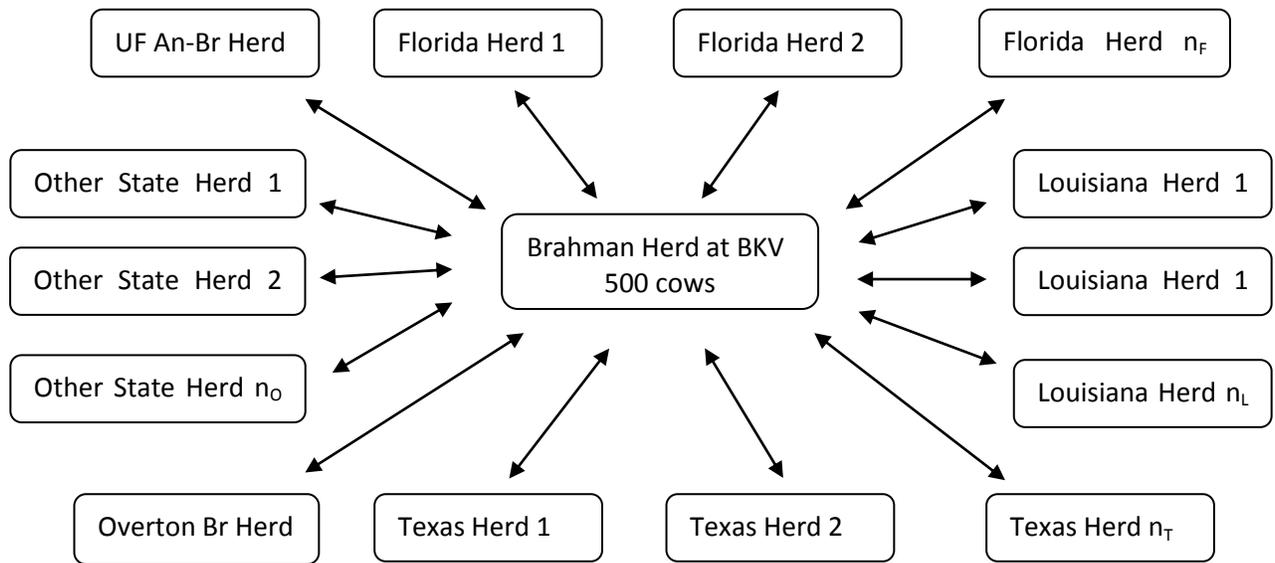|	MR TAES 7145	MR TAES 0107	KCC 272OF 185-176	Total
Heifers	0	26	0	26
Cows	33	7	31	71
Total	33	33	31	97

Figure 1. Structure of the population of the Brahman project (arrows indicate genetic connectedness among herds)