What Amount Of Brahman Influence Will Meet The Targets Of Specific Programs?

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Introduction

According to the United States Department of Agriculture (USDA, 2001), in December 2001 there were 44 branded beef programs in the United States, and 40 of them (91%) imposed a restriction on the amount of Brahman breeding. Brahman and high-percentage Brahman carcasses were considered too variable in their degree of tenderness to be acceptable for branded beef products. However, environmental and management conditions in Florida and in other Southeastern states of the USA favor the use of Brahman influenced cattle over completely *Bos taurus* cattle of British and continental origin. It is likely that beef cattle containing some Brahman fraction will continue to be the predominant type in the Southern region of the USA in the foreseeable future. The purpose of this paper is to objectively discuss the carcass characteristics of Brahman and Brahman influenced cattle and of one *Bos taurus* breed (Angus) according to the traits and restrictions imposed by branded beef programs, using information from the Angus-Brahman multibreed herd of the University of Florida. Because Florida is primarily a cow-calf state, growth traits will also be discussed. Trait results will be presented in terms of actual values (phenotypes) and of predicted genetic values. Analyses of predicted genetic values of the parents of the Angus, Brahman, Brangus, and various Angus × Brahman crossbred calves produced in the multibreed herd should help to better understand phenotypic values and shed some light on the growth and carcass characteristics of Brahman influenced cattle as a whole.

Main Characteristics Of Branded Beef Programs In The USA

Branded beef programs have a series of requirements that animals and carcasses must meet to be accepted within each brand name (USDA, 2001). These requirements were grouped into six categories: 1) live requirements, 2) carcass characteristics, 3) yield factors, 4) quality factors, 5) USDA information, and 6) management claims.

Live requirements are used by breed branded beef products (e.g., Angus, Hereford) to include crossbred animals in their categories (70% of branded beef programs). Live requirements are either genetic or phenotypic. For example, Angus branded beef programs require animals to be either progeny of one registered Angus or grandprogeny of two registered grandparents. Certification by phenotype requires animals to be 51% solid black. Hereford-branded beef programs have similar requirements.

Carcass characteristics preclude carcasses with ribeye internal hemorrhages and “dark cutting” characteristics (100% branded beef programs), hump heights taller than 2 inches (91% branded beef programs), and except for two branded beef programs, allow only steer and heifer carcasses (96% branded beef programs).

Yield factors include yield grade (no requirement: 43%, 2.9 or less: 2%, 3.9 or less: 32%, and 4.9 or less: 23% of branded beef programs), fat thickness (no requirement: 95%, .7 inches or less, or 1.1 inches: 5% of branded beef programs), ribeye area (no requirement: 91%; larger than or equal to 11 square inches, or between 11 and 17 square inches: 9% of branded beef programs), muscling (no requirement: 20%; moderately thick: 80% of branded beef programs), and hot carcass weight (no requirement: 82%; larger than or equal to 600 pounds or between 600 and 950 pounds: 18% of branded beef programs).

Quality factors are quality grade (prime: 50%, choice: 82%, and select: 32% of branded beef programs), marbling (slightly abundant to abundant: 50%, small to moderate: 82%, and slight: 32% of branded beef programs), marbling texture (no requirement: 48%, and medium to fine marbling texture: 52% of branded beef programs), and maturity (no requirement: 7%, A and A/B maturity: 89%, and A to E maturity: 5% of branded beef programs).

USDA information refers to a schedule number (a description of the requirements of a specific beef program), the initial release date and effective date of the beef program, whether the beef program is USDA certified (98% are USDA certified) and USDA verified (5% are USDA verified).

Management claims are additional management (9%) and breed (7%) requirements of some branded beef programs.

The Angus-Brahman Multibreed Herd Of The University Of Florida

The Angus-Brahman multibreed herd was established in 1988 to conduct intrabreed and multibreed animal breeding and management research in a herd whose composition was a reflection of the types of animals commonly found in Florida and in other Southern states. The herd is composed of Angus (A), Brahman (B), ¾ A ¼ B, ½ A ½ B, ¼ A ¾ B, and Brangus (5/8 A 3/8 B) interbreeding mating groups of sires and dams. The term interbreeding here means that a sire is mated to dams of all breed groups. That is, *sires are mated across all breed groups of dams* following a diallel design. Sires come from inside and outside the herd. In particular, Angus, Brahman, and Brangus sires included in their national sire evaluations were used in order to create connectedness with the national herd of these breeds. This is a self-perpetuating herd in that replacement females from all breed groups can be produced within the herd.

There is currently reproduction, management, growth, and carcass information on 2910 calves (between 143 and 951 per breed group) born from 1989 to 2001. These calves were the progeny of 153 sires (between 12 and 42 per breed group) and 1124 dams (between 113 and 293 per breed group). Figure 1 shows the number of sires, dams, and calves by breed-group-of-sire × breed-group-of-dam combination for the 1989 to 2001 period. Notice that larger numbers of dams were mated to produce Angus, Brahman, and Brangus replacements.

The growth traits used to compare Angus, Brahman, Brangus, and A × B crossbred animals will be: 1) birth weight, 2) weaning weight, 3) weaning weight adjusted to 205 days, 4) yearling weight, 5) yearling weight adjusted to 365 days, 6) feedlot average daily gain, 7) slaughter weight, 8) slaughter age, and 9) 550-day weight.

Carcass information was collected only on steers slaughtered when they had between .35 and .55 inches of backfat thickness. Thus, all carcasses fell into the category of A maturity. Steers were slaughtered at the Meats Laboratory of the Animal Sciences Department of the University of Florida, and at other facilities in Florida and elsewhere. The incidence of “dark cutting” characteristics was extremely rare (2 out of 827 slaughtered steers), and there were no reports of internal hemorrhages of the ribeye muscle. Marbling texture was not measured.

Thus, to compare Angus, Brahman, Brangus, and A × B crossbred animals for carcass traits, only the following requirements of the branded beef programs will be considered: 1) live requirements: 51% black, when relevant for specific black Angus branded beef programs, 2) carcass requirements: hump height less than or equal to 2 inches, 3) yield requirements: hot carcass weight (600 to 950 pounds), dressing percentage, fat over the ribeye (0 to 1.1 inches), ribeye area (larger than or equal to 11 square inches, or between 11 and 17 square inches), and yield grade (2.9 to 4.9), and 4) quality requirements: marbling (small to medium: 400 to 699), slight: 300 to 399, and traces: 200 to 299), and quality grade (choice: 600 to 699, select: 500 to 599, and standard: 400 to 499). USDA information and management claims will not be included in the discussion.

Results And Discussion

Results will be entirely presented in graphical form. Graphs will be of two kinds: 1) Actual records and moving averages (Investopedia.com, 2002) of 100 actual records (the first moving average is computed using records 1 to 100, the second one using records 2 to 101, and so on), and 2) multibreed genetic predictions. Graphs were created using Quattro Pro version 9. Animals in graphs were sorted by Brahman fraction of the calf, Brahman fraction of the sire of the calf, and Brahman fraction of the dam of the calf. To simplify the notation, the abscissa of each graph contains numbers 1 to 6, one for each breed group: 1 = Angus (100% to 81% Angus), 2 = .75 A (80% to 61% Angus), 6 = Brangus (62.5% Angus), 3 = .5 A (60% to 41% Angus), 4 = .25 A (40% to 21% Angus), and 5 = Brahman (20% to 0% Angus). The ordinate of each graph contains values of traits expressed in the American system (inches, pounds), except for Warner-Bratzler Shear Force (expressed in kg), and categories (e.g., 1 = extremely tough to 8 = extremely tender, for tenderness).

Numbers of Sires

	BGS					
BGD	A	.75A	.50A	.25A	B	Br
A	27	9	15	17	26	26
.75A	20	12	15	15	27	20
.50A	27	11	15	17	31	29
.25A	20	9	13	13	24	16
B	19	11	13	16	42	21
Br	19	8	13	15	21	31

Numbers of Dams

	BGS					
BGD	A	.75A	.50A	.25A	B	Br
A	110	43	75	42	55	32
.75A	28	26	39	25	38	15
.50A	42	30	59	36	49	29
.25A	88	36	69	40	54	33
B	86	45	90	48	258	33
Br	95	38	101	41	52	127

Numbers of Calves

	BGS					
BGD	A	.75A	.50A	.25A	B	Br
A	200	31	48	107	101	128
.75A	50	28	38	46	51	50
.50A	98	44	79	93	114	164
.25A	51	28	40	52	60	47
B	65	43	52	62	495	61
Br	40	15	32	36	38	223

Figure 1. Number of sires, dams, and calves by breed-group-of-sire × breed-group-of-dam combination in the Angus-Brahman multibreed herd.

Multibreed genetic predictions were obtained using single-trait maternal grandsire multibreed models (Elzo and Wakeman, 1998). Fixed environmental effects were contemporary groups and ages of dam. Fixed genetic effects were additive and nonadditive intra and interbreed genetic effects. Random effects were sire additive and nonadditive genetic effects and residual. The model for growth traits included direct and maternal effects, and only direct effects for carcass traits. Direct genetic effects measure an animal's ability to perform. Maternal genetic effects refer to maternal care, especially milk production. Additive genetic effects were predicted as deviations from average Brahman additive genetic effects. Nonadditive genetic effects were predicted as deviations from the average of intrabreed Angus and Brahman intrabreed interaction effects. Computations were performed using the MREMLEM program (Elzo, 2002). The multibreed model used here differed from multibreed national sire evaluation models in that 1) it used sires and maternal grandsires instead of calves and dams, 2) it computed random nonadditive intra and interbreed nonadditive genetic predictions, and 3) it computed total direct and maternal genetic predictions. For simplicity, graphs for growth traits only contain predictions for total direct and total maternal genetic effects. Carcass trait graphs show additive, nonadditive, and total direct genetic effects. Lastly, growth and carcass graphs show nonadditive and total genetic predictions of sires mated to ½ Angus ½ Brahman dams. This was done to make the expected nonadditive fraction of Angus/Brahman interactions in all matings equal to ½. This would make sire comparisons more fair because progeny from all sires would have the same amount of nonadditive interactions regardless of the breed composition of their sires.

Growth Traits

Growth traits will be presented in the following order: 1) birth weight, 2) weaning weight (unadjusted, 205-d), 3) yearling weight (unadjusted, 365-d), 4) feedlot average daily gain, and 5) slaughter weight, slaughter age, and 550-d weight. For each trait there are two graphs: one with phenotypic results (actual measurements and 100-record moving averages), and another with multibreed genetic predictions. The purpose of the graphs with genetic predictions is to help explain phenotypic results and to help understand the connection between the actual trait measurements and the underlying additive and nonadditive genetic effects.

Birth Weight. Figure 2 contains the graphs of phenotypic calf birth weights and moving averages, and of total direct and maternal genetic predictions.

The phenotypic graph in Figure 2 suggests a similar degree of variability across all breed groups of calves, and the moving average shows an upward trend from Angus to Brahman calves. The genetic graph indicates that Brahman, 75% Brahman, and ½ Brahman sires would tend to produce heavier calves at birth compared to Angus, 75% Angus, and Brangus sires due to direct genetic effects, and

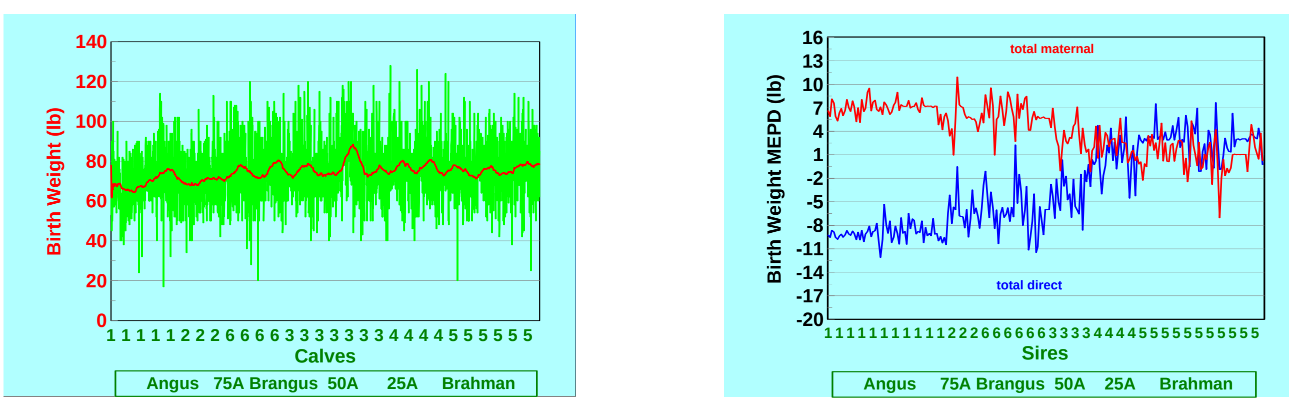

Figure 2. Calf birth weights, moving averages, and sire total direct and maternal multibreed expected progeny differences in the Angus-Brahman multibreed herd.

that their maternal effect would produce the opposite effect. This means that, on the average, the heaviest calves will likely be those of Brahman sires mated to Angus cows and the lightest ones will likely be straightbred Angus. The largest phenotypic average for birth weight was that of the F1 calves from the Brahman sires × Angus dams combination (89.1 pounds), and Angus calves had the second smallest average (66.6 pounds), which is close enough to the expected outcome given the small size of the multibreed data set.

Weaning Weight. Figure 3 contains phenotypic and genetic graphs for unadjusted weaning weights, and Figure 4 shows the corresponding graphs for weaning weights adjusted to 205 days of age. Calves from Angus and A × B crossbred dams were weaned in early September, and those from Brahman dams in early October. This was done because Brahman dams were mated approximately one month later than Angus and A × B dams.

The moving average of the unadjusted and 205-d adjusted weaning weights show a convex arch between Angus and Brahman calves. Straightbred Angus and Brahman calves had smaller phenotypic unadjusted and 205-d adjusted weaning weights than crossbred calves. The smaller weights for Brahman calves in the unadjusted weaning weight graph occurred largely because Brahman calves were younger at weaning (about one month) than Angus and A × B crossbred calves. Because most calves were older than 205 days at weaning the 205-d

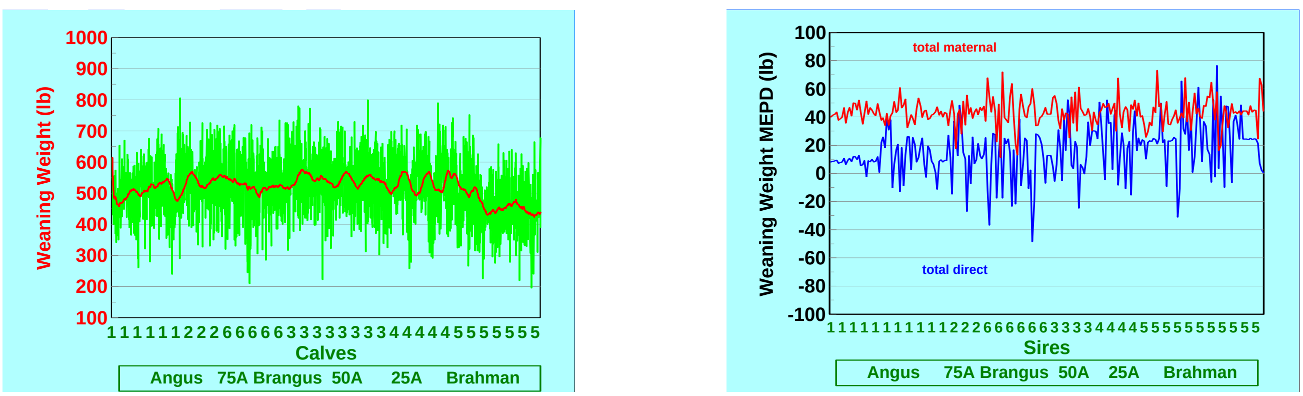

Figure 3. Calf weaning weights, moving averages, and sire total direct and maternal multibreed expected progeny differences in the Angus-Brahman multibreed herd.

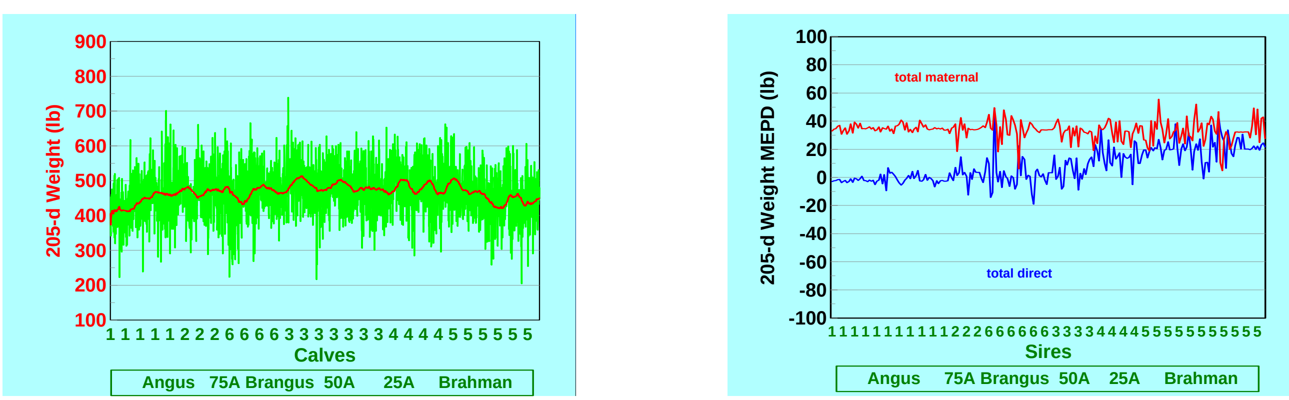

Figure 4. Calf 205-d weights, moving averages, and sire total direct and maternal multibreed expected progeny differences in the Angus-Brahman multibreed herd.

moving average shows a drop of about 100 pounds relative to the unadjusted one. In addition, there is a decrease in variability, which also appears in the genetic graphs. The genetic graphs also show that Brahman and 75% Brahman sires had higher predictions for direct genetic effects for 205-d weights than Angus, 75% Angus, Brangus, and 50% Brahman sires. This difference is less evident in the sire predictions for unadjusted weaning weights. Predictions for maternal effects were comparable across all breed groups of sires, although A × B crossbred and Brahman sires showed more genetic variability than Angus sires. The largest average phenotypic unadjusted weaning weight was for calves from the mating of Brahman sires and 75% Brahman dams (581 pounds), and the smallest was for calves from the mating of 50% Angus sires and Brahman dams (441 pounds). The largest phenotypic average 205-d weight belonged to calves from Brahman sires and Brangus dams (508.3 pounds), and the smallest was that of Angus calves (426 pounds).

Yearling Weight. Calf phenotypic values and multibreed sire predictions of unadjusted yearling weights are presented in Figure 5, and those for 365-d adjusted weights in Figure 6.

The patterns of unadjusted and adjusted yearling weights and of genetic predictions is similar to that observed for weaning weights. Crossbred calves continue to have larger weights than straightbred Angus and Brahman calves. Brahman-sired calves continue to be heavier than calves from other breed groups. Calves from Brahman sires and

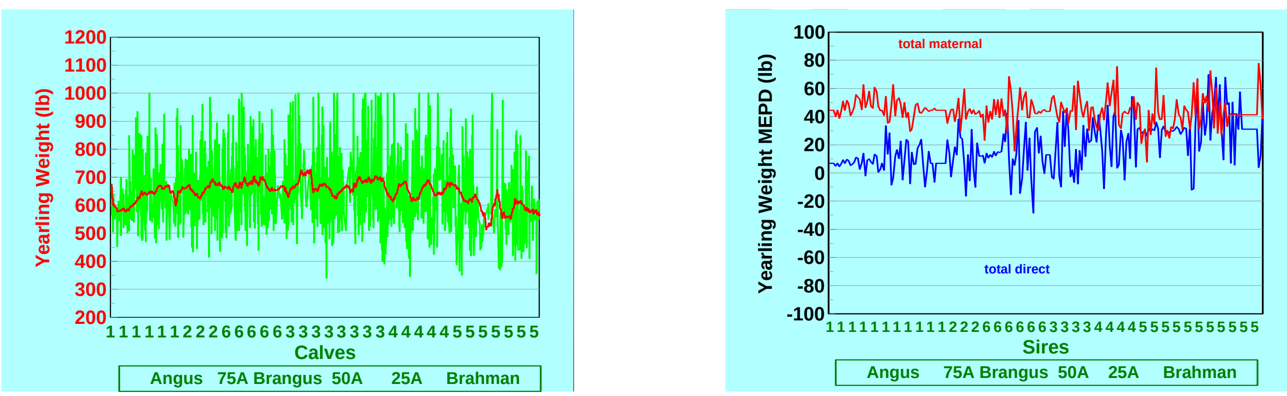

Figure 5. Calf yearling weights, moving averages, and sire total direct and maternal multibreed expected progeny differences in the Angus-Brahman multibreed herd.

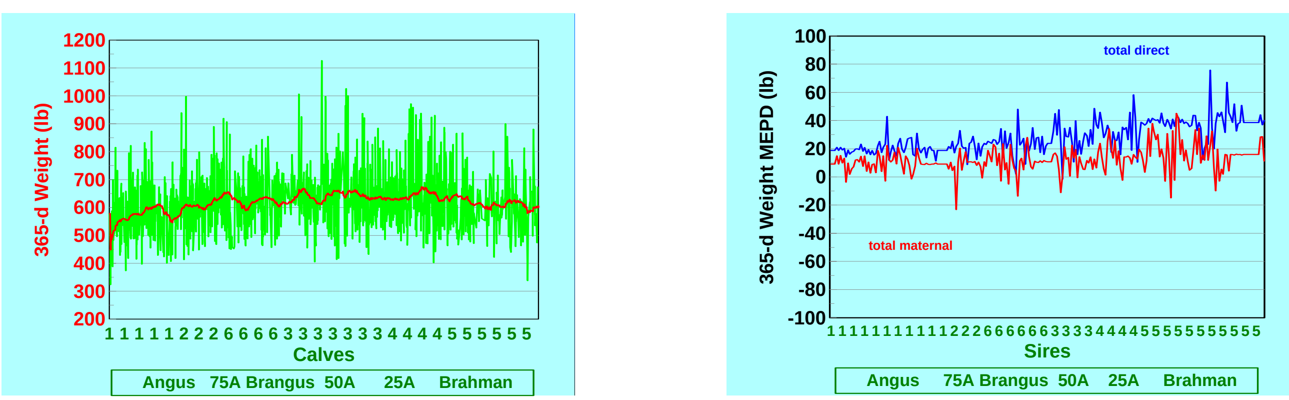

Figure 6. Calf 365-d weights, moving averages, and sire total direct and maternal multibreed expected progeny differences in the Angus-Brahman multibreed herd.

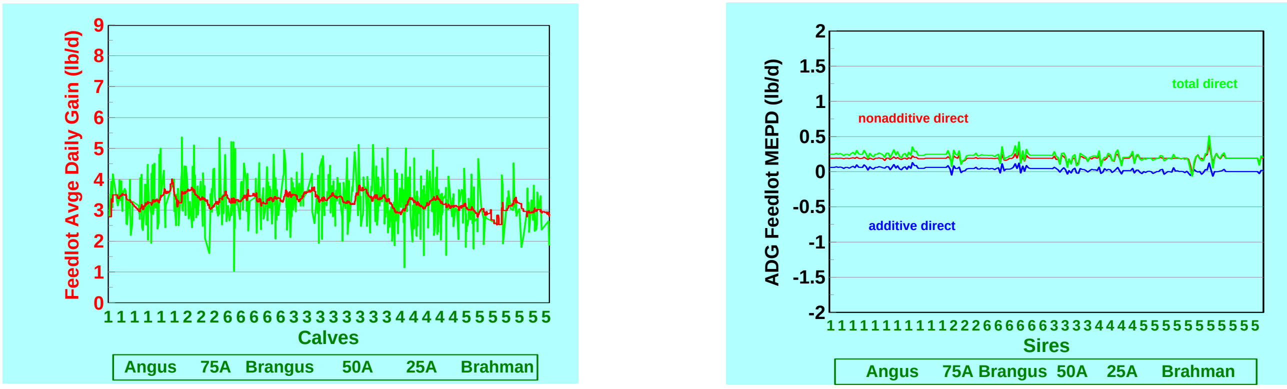

Figure 7. Steer feedlot average daily gains, moving averages, and sire additive, nonadditive, and total direct multibreed expected progeny differences in the Angus-Brahman multibreed herd.

75% Brahman dams had the largest average unadjusted yearling weights (697.4 pounds). Genetic predictions for crossbred sires continue to show larger variability than straightbred sires.

Feedlot Average Daily Gain. Yearling steer calves were sent to a feedlot to be fed until their ultrasound backfat thickness was between .35 and .55 inches. The time steers spent in the feedlot ranged from three to six months. Angus and A × B crossbred calves tended to have somewhat higher average daily gains (Figure 7) than Brahman calves. Genetically this amounted to a difference of about .2 pounds/day between Angus and Brahman sire predicted total genetic values (Figure 7).

Slaughter Weight And Slaughter Age. Steer calves were slaughtered when they reached between .35 and .55 inches of ultrasound backfat thickness. The objective was to slaughter steers at a similar fat thickness endpoint. Thus, genetic background, ultrasound backfat measurement, and slaughter age contributed to the steer phenotypic and sire genetic variation found for slaughter weights (Figure 8).

Crossbred steers were heavier on the average than straightbred Angus and Brahman steers. In part, Brahman steers had lighter average slaughter weights because, on the average, they tended to be younger than A × B crossbred and Angus steers at slaughter (Figure 9). Age was probably the main reason for Brahman steers to have had lighter slaughter weights than Angus. Brahman steers were 30 days younger at slaughter than Angus calves (553 days vs 583 days). However, there were eight breed group combinations whose average slaughter ages were younger and had slaughter weights comparable to Brahman steers. The graph of multibreed sire predictions for direct genetic effects for slaughter weight shows an upward trend from Angus to Brahman, and the nonadditive line shows an advantage of Angus/Brahman interaction of about 40 pounds over the mean of intrabreed Angus and Brahman interactions. Thus, crossbred steers with high percent of Brahman breeding will tend to be heavier than crossbred steers with low percent Brahman, and straightbred Brahman steers.

550-Day Weight. This adjusted weight provides a clearer depiction of the growth potential of Angus, Brahman, and A × B crossbred animals as replacement animals than do similar-backfat-thickness slaughter weights. Figure 10 shows a phenotypic pattern that is similar to earlier growth stages (birth, weaning, yearling), with crossbred animals having larger weights than straightbred animals, predicted direct sire genetic effects favoring Brahman, and predicted maternal effects favoring Angus.

Carcass Traits

Angus, Brahman, Brangus, and A × B crossbred animals will be compared using the following carcass traits grouped according to the requirements of branded beef programs: 1) carcass characteristics: hump height less than or equal to 2 inches, 2) yield characteristics: hot carcass weight (600 to 950 pounds), dressing percentage, fat over the ribeye (0 to 1.1 inches), ribeye area (larger than or equal to 11 square inches, or between 11 and 17 square inches), and yield grade (2.9 to 4.9), and 3) quality characteristics: marbling (small to medium: 400 to 699), slight: 300 to 399, and traces: 200 to 299), and quality grade (choice: 600 to 699, select: 500 to 599, and standard: 400 to 499). The live requirement of 51% black will be used only when discussing specific black Angus branded beef programs. As with growth traits, each carcass trait will be discussed using two graphs: one containing phenotypic results (actual measurements and 100-record moving averages), and another one showing multibreed predictions for direct genetic effects.

Carcass Characteristics: Hump Height

Hump Height. Hump height was measured as the distance between the dorsal point of the ligament nuchae to the dorsal most point of the rhomboideous muscle. This measurement is different from the USDA measure of hump height (USDA, 1994), which measures the height of the lean muscle (excluding fat) in the center of the hump that is perpendicular to a line formed by the extension of the top line (including fat). It appears that the hump height measured here (heretofore UFL hump height) is on the average 3 inches longer than the USDA hump height measurement, and that this distance corresponds to the distance between the

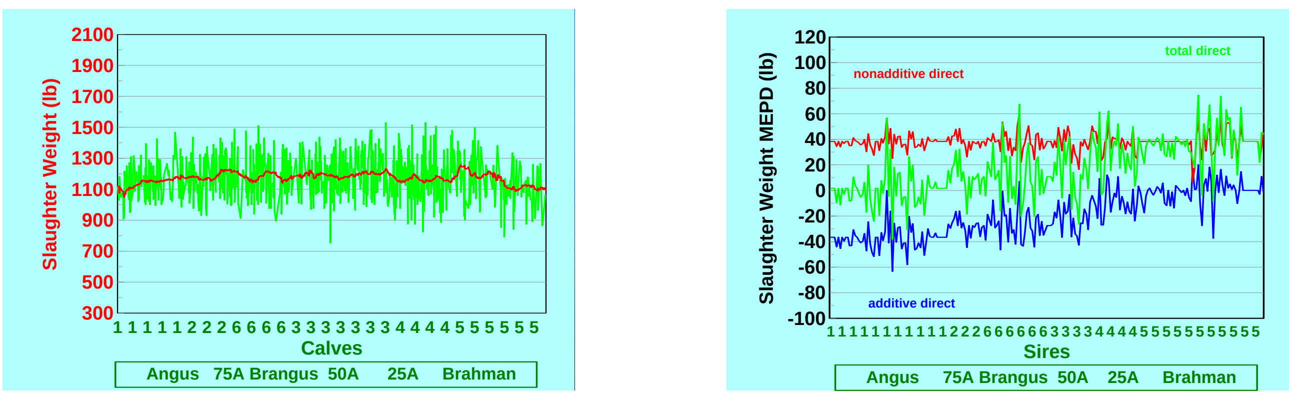

Figure 8. Steer slaughter weights, moving averages, and sire additive, nonadditive, and total multibreed expected progeny differences in the Angus-Brahman multibreed herd.

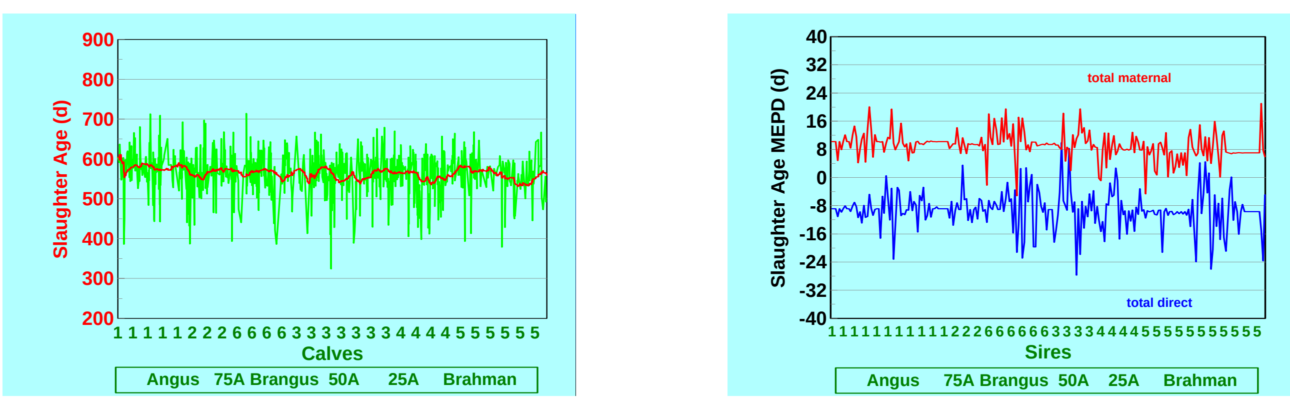

Figure 9. Steer slaughter ages, moving averages, and sire total direct and maternal multibreed expected progeny differences in the Angus-Brahman multibreed herd.

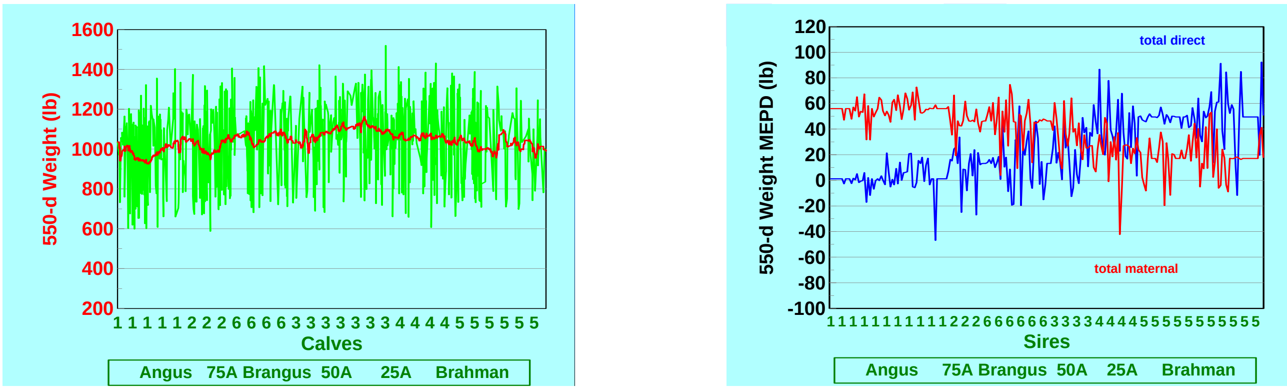

Figure 10. Steer and heifer 550-d weights, moving averages, and sire total direct and maternal multibreed expected progeny differences in the Angus-Brahman multibreed herd.

extension of the top line and the dorsal aspect of the ligament nuchae. Thus, regardless of the actual difference between the two measures, if UFL hump heights from all steers are deviated from the mean UFL hump height of Angus steers (about 3 inches, Figure 11), the resulting difference should give a reasonably close approximation to the USDA measure of hump height.

The graph of phenotypic values of hump heights shows a clear upward trend between Angus and Brahman (Figure 11), suggesting a mostly additive mode of inheritance. This is confirmed by the graph of sire predicted genetic values, which shows an average nonadditive genetic effect of less than .5 inches, compared to a difference of 1.5 inches between Angus and Brahman. However, there is a substantial amount of phenotypic variability for this trait. Phenotypically, animals with a 50% difference in Brahman breeding may have similar hump heights. Genetically, differences in sire predicted direct genetic values for hump height seem to be more distinct and predictable: Angus and some Brangus sires would produce calves with the smallest humps, and Brahman sires would generate calves with the largest humps.

Crossbred and Brahman calves hump height deviations from Angus indicate that branded beef programs that included the 2 inch-or-less restriction on hump height would have excluded about 10% of 50% Brahman steers, about 60% of 75% Brahman steers, and 80% of Brahman steers in the Angus-Brahman multibreed herd. All Brahman steers would also have been excluded because of phenotype and(or) genotype live requirements by 70% of branded beef programs.

Yield Characteristics: Hot Carcass Weight, Dressing Percent, Fat Over The Ribeye, Ribeye Area, And Yield Grade

Hot Carcass Weight. Phenotypically, hot carcass weights tended to be larger for Brahman and A × B crossbred steers than for Angus steers (Figure 12). Genetically there was a clear upward trend in sire additive direct and total genetic predictions for hot carcass weights from Angus to Brahman. Interbreed sire nonadditive genetic effects were about half the values of additive genetic effects and less variable than sire additive and total direct predicted genetic values. Phenotypic and genetic variability were large however, indicating that carcasses of similar weight ranges would exist in all steer breed groups. Brahman, 75% Brahman, Brangus, and 25% Brahman sired steers tended to have, on the average, heavier carcasses than Angus and 50% Brahman sired calves. The restriction of 600 to 900 pounds imposed by a few branded beef programs (9%) would exclude a similar fraction of carcasses across all breed groups.

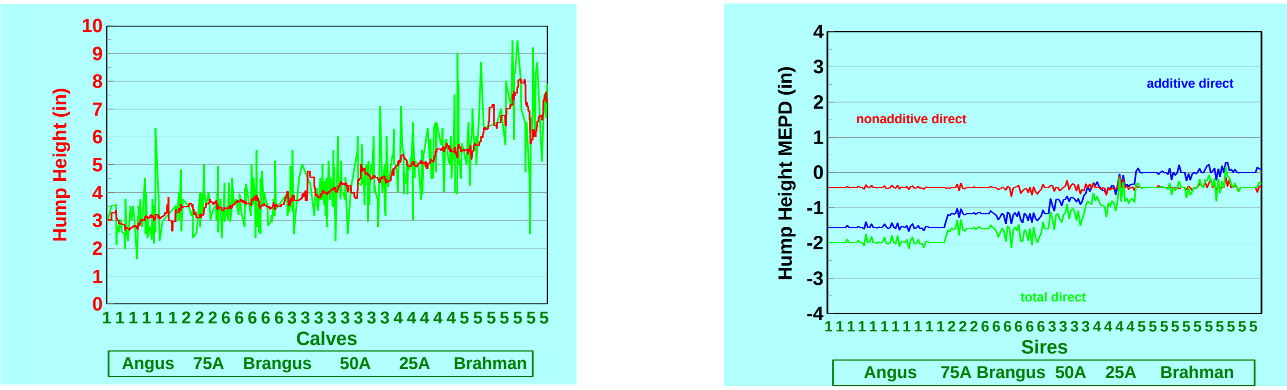

Figure 11. Steer hump heights, moving averages, and sire additive, nonadditive, and total direct multibreed expected progeny differences in the Angus-Brahman multibreed herd.

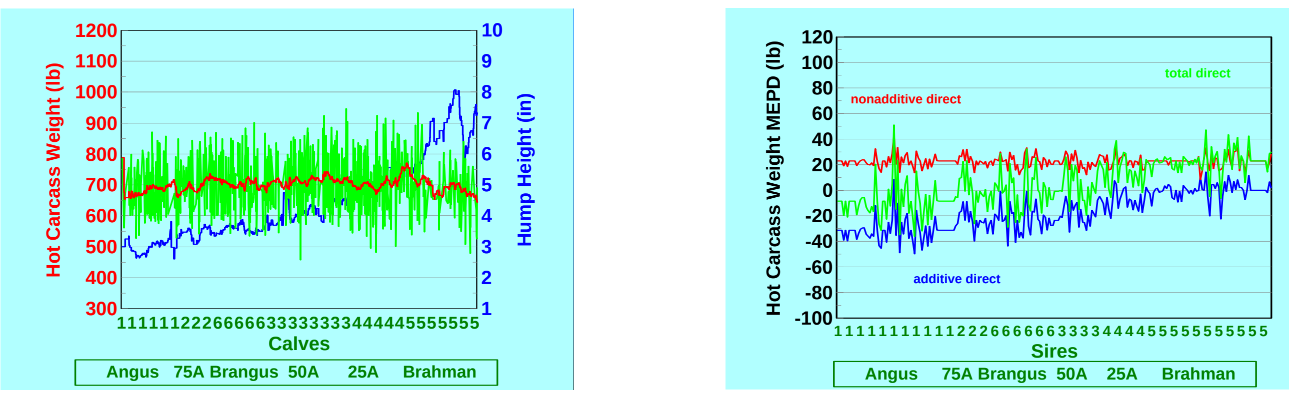

Figure 12. Steer hot carcass weights, moving averages, and sire additive, nonadditive, and total direct multibreed expected progeny differences in the Angus-Brahman multibreed herd.

Dressing Percentage. This trait was included here for completeness, although it is not one of the yield traits restricted by branded beef programs. There was a small difference (Figure 13) in phenotypic dressing percentage between Angus and Brahman steers (about 1% in favor of Brahman). Genetically, this difference was likely to be almost entirely due to additive direct genetic effects. Predicted nonadditive genetic effects were close to zero for sires of all breed groups.

Fat Over The Ribeye. This trait was included here because it is part of the set of restrictions on yield traits, although its variability was highly controlled because animals were slaughtered using a similar backfat thickness endpoint. Some phenotypic variability still remained for this trait because animals were not slaughtered at exactly the same backfat endpoint, but the genetic variability was tightly controlled as shown in the graph of sire multibreed predictions (Figure 14). Most branded beef programs imposed no restrictions on backfat thickness. The severest restriction (.7 inches or less) would have eliminated only a few A × B crossbred steers.

Ribeye Area. Phenotypically, ribeye areas tended to be smaller for straightbred Angus and Brahman than for crossbreds, although the difference was small (about 1 square inch on the average). Phenotypic variation was sizable, with values ranging from about 8 to 18 square inches. Genetically, there was a small difference in sire additive direct genetic predictions from Angus to Brahman. Nonadditive sire genetic predictions were all small (.25 square inches or less) and mostly on the positive side, suggesting a small advantage of crossbred over purebred steers (Figure 15).

Branded beef programs that imposed a minimum ribeye area of 11 square inches would have eliminated approximately 25% Angus, 25% ¾ A, 27% Brangus, 17% ½ A, 27% ¼ A, and 26% Brahman carcasses. Most steer carcasses (76%) had ribeye areas between 11 and 16.5 square inches. Thus, branded beef programs that imposed an upper limit of 16.5 or 17 square inches would have eliminated only one carcass (from a Brahman steer).

Yield Grade. The vast majority of carcasses of steers of all breed groups had yield grades below 4. The moving average of yield grade suggests that straightbred Angus and Brahman tended to have slightly lower values of yield grade (hence higher percentage of boneless, closely trimmed retail cuts). Phenotypic values showed similar range of values across all steer breed groups (between 1 and 4.2). Genetically, sires differed little in their additive and nonadditive direct predicted ability (Figure 16).

About 57% of the branded beef programs impose the restriction that carcasses must have a yield grade of 2.9, 3.9, or 4.9. The program that required carcasses to have yield grades of 2.9 or less would have accepted 63% of carcasses (75% Angus, 56% ¾ A, 64% Brangus, 64% ½ A, 53% ¼ A, and 54% Brahman), whereas those that required yield grades of 3.9 or less would have accepted 98% of all carcasses (98% Angus, 95% ¾ A, 97% Brangus, 98% ½ A, 96% ¼ A, and 99% Brahman), and those that required 4.9 would have accepted all carcasses. It should be

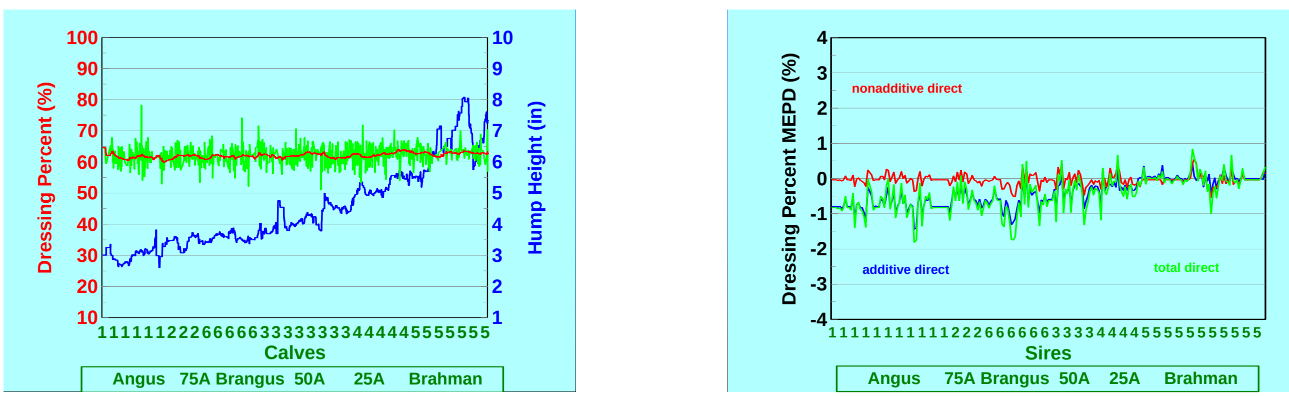

Figure 13. Steer dressing percentages, moving averages, and sire additive, nonadditive, and total direct multibreed expected progeny differences in the Angus-Brahman multibreed herd.

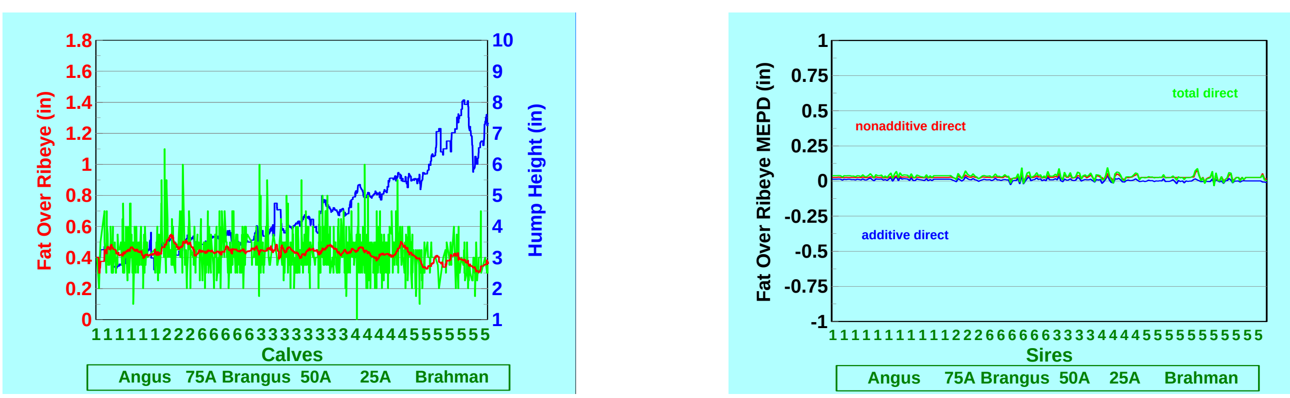

Figure 14. Steer fat over the ribeye, moving averages, and sire additive, nonadditive, and total direct multibreed expected progeny differences in the Angus-Brahman multibreed herd.

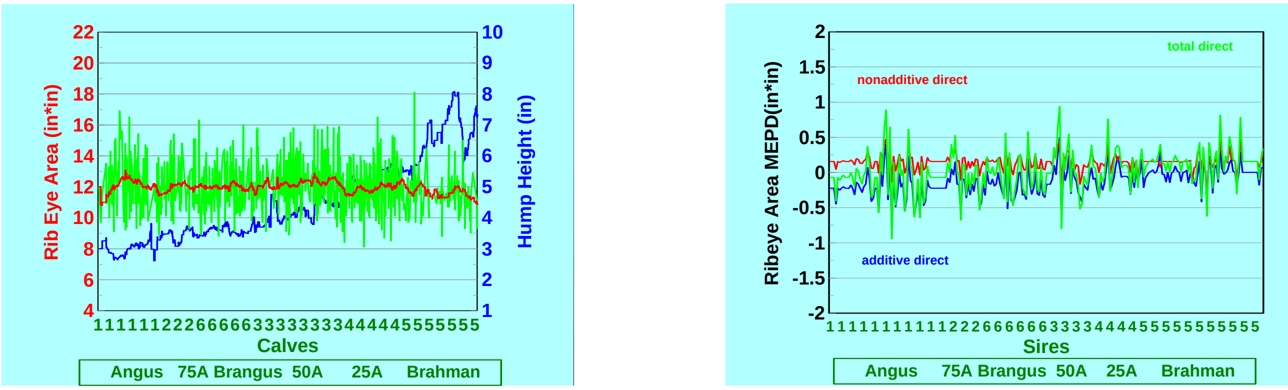

Figure 15. Steer ribeye areas, moving averages, and sire additive, nonadditive, and total direct multibreed expected progeny differences in the Angus-Brahman multibreed herd.

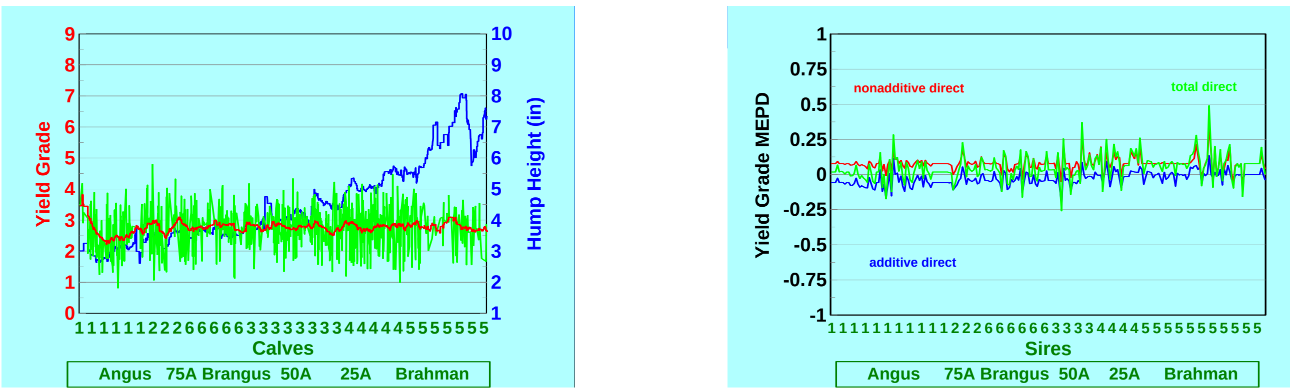

Figure 16. Steer yield grades, moving averages, and sire additive, nonadditive, and total direct multibreed expected progeny differences in the Angus-Brahman multibreed herd.

noticed that yield grade is heavily influenced by fat over the ribeye. Thus, had steers been slaughtered at a lower backfat thickness endpoint (e.g., .2 inches), probably most carcasses would have been eligible for branded beef programs requiring a maximum yield grade of 2.9.

Quality Characteristics: Marbling, Quality Grade, WB Shear Force 5 Days, WB Shear Force 14 Days, And Tenderness

Marbling And Quality Grade. Given a degree of maturity (e.g., A maturity as in the Angus-Brahman multibreed data set), marbling is the deciding factor in the categorization of animals for quality grade. Thus, marbling phenotypic and genetic graphs (Figure 17) showed trends very similar to those obtained for quality grade (Figure 18). The moving average lines for marbling and quality grade depict decreasing phenotypic trends from 100% Angus to 100% Brahman steer carcasses. On the average, marbling scores dropped from about 450 (small) to 350 (slight), and quality grade scores fell from 610 (choice) to 540 (select). Similar trends occurred for sire direct additive and total genetic predictions. Nonadditive direct genetic effects appeared to have played a minor role in the genetic determination of these traits. Although some predicted nonadditive genetic variation existed, it was smaller than the additive genetic variation present among sires of all breed groups.

Most crossbred steer carcasses in the Angus-Brahman herd had marbling scores between 300 (slight) and 500 (modest). Some Angus, Brangus, and crossbred steer carcasses reached marbling scores of 600 and higher (moderate). All breed groups had some steer carcasses with marbling scores below 300 (traces, practically devoid). In terms of quality grades, most carcasses had scores between 500 (select) and 650 (choice). No carcasses qualified for prime, and all breed groups had carcasses with scores between 400 and 499 (standard). Branded beef programs that require quality grades to be prime or choice would have accepted 47% Angus, 34% ¾ A, 31% Brangus, 23% ½ A, 15% ¼ A, and 13% Brahman carcasses, whereas those requiring choice and select would have accepted 95% Angus, 95% ¾ A, 92% Brangus, 89% ½ A, 83% ¼ A, and 76% Brahman carcasses. It should be noticed that the phenotypic variation among marbling scores was substantially larger than that of quality grades. Thus, some animals (particularly Brahman) that would have been eliminated because of branded beef marbling restrictions would have been accepted under their quality grade restrictions.

WB Shear Force 5 Days, WB Shear Force 14 Days, And Tenderness. Warner-Bratzler shear force was substantially more variable at 5 days postmortem (Figure 19) than at 14 days postmortem (Figure 20) in steer carcasses of all breed groups. Further, the moving average line indicates a steeper upward trend from Angus to Brahman carcasses at 5 days (approximate increase of 2 kg of shear force) than at 14 days postmortem (about .5 kg increase in shear force). Genetic prediction graphs were in complete agreement with phenotypic graphs for these traits. Angus sires had predicted additive direct and total genetic values that were approximately 1 kg below at 5 days and .5 kg below at 14 days than those of Brahman sires. Brangus and crossbred sires had intermediate values between Angus and Brahman sires. The same as with other carcass traits, nonadditive direct genetic effects were close to zero, with some variation among sires of all breed groups. Larger amounts of variation among sires of all breed groups existed for additive direct and total genetic effects. Consequently, there were Angus, 75% Angus, Brangus, and 50% Angus sires that had similar direct and total predicted genetic values for shear force at 5 days postmortem, whereas 75% Brahman and Brahman sires had somewhat larger values.

At 14 days postmortem however, differences among direct additive and total predicted genetic values decreased dramatically. Thus, at 14 days postmortem, there were sires of all breed groups that had similar predicted differences. There was still, however, a small but noticeable difference suggesting that progeny of Angus sires would yield carcasses with lower shear force values at 14 days than those from progeny of Brahman sires. Crossbred and Brangus sires continued to have intermediate predicted additive genetic values at this aging time.

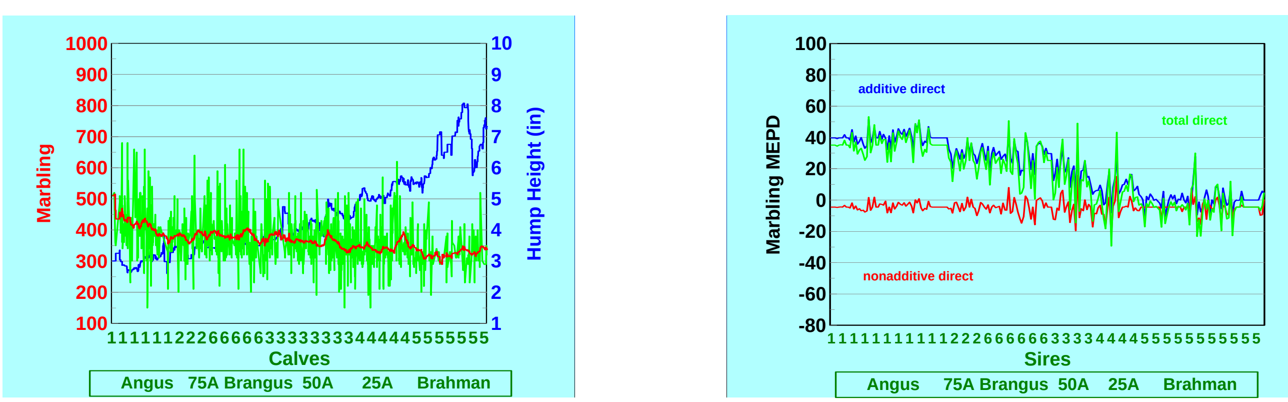

Figure 17. Steer marbling scores, moving averages, and sire additive, nonadditive, and total direct multibreed expected progeny differences in the Angus-Brahman multibreed herd.

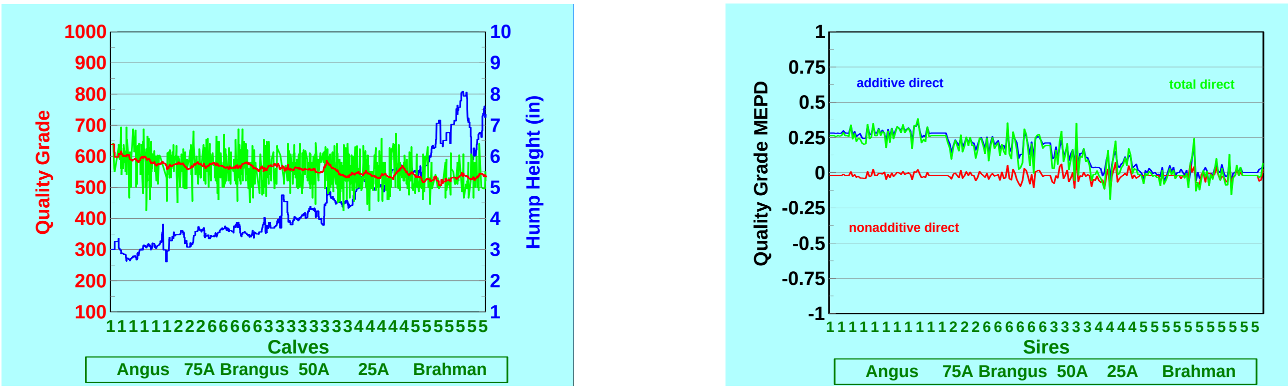

Figure 18. Steer quality grades, moving averages, and sire additive, nonadditive, and total direct multibreed expected progeny differences in the Angus-Brahman multibreed herd.

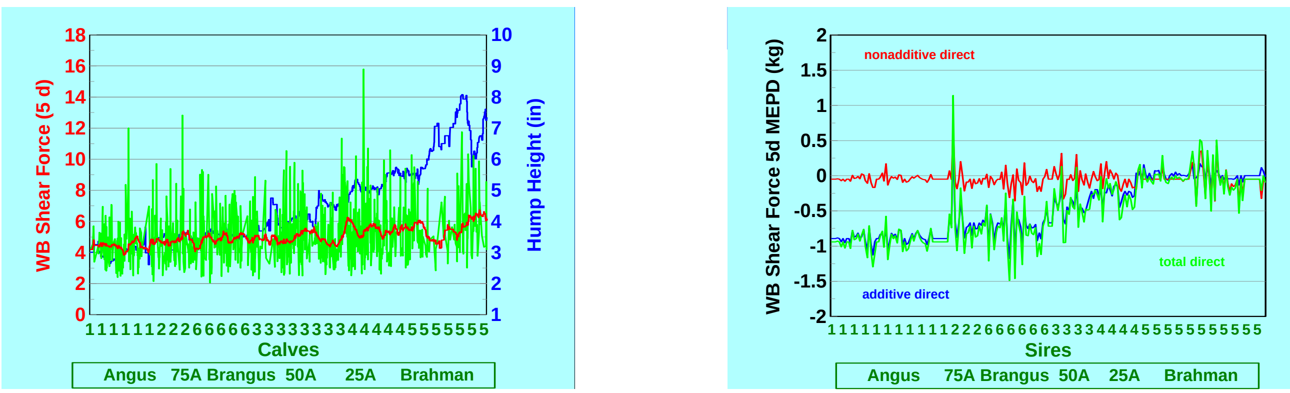

Figure 19. Steer WB shear force at 5 days, moving averages, and sire additive, nonadditive, and total direct multibreed expected progeny differences in the Angus-Brahman multibreed herd.

The increasing trend in shear force between Angus and Brahman steer carcasses translated into a downward trend in tenderness scores (taste-panel evaluated 14 days postmortem) from Angus to Brahman (Figure 21). The tenderness moving average went from approximately 6 (moderately tender) for Angus steers to 4 (moderately tough) for Brahman steers. This Angus to Brahman downward trend was supported by the trend obtained for the predicted additive and total direct genetic effects. Angus sires had predicted additive and total genetic values that were, on the average, about 1 point larger than Brahman sires. Crossbred sires had intermediate values, and Brangus sires had values closer to those of Angus sires, but they were substantially more variable. Phenotypic variability was large for all steer breed groups, and because of it there were steer carcasses with tenderness values between 4 (slightly tough) and 3 (moderately tough) in all breed groups. At the other end of the scale, only some Angus, 75% Angus, Brangus, 50% Angus, and 75% Brahman carcasses had tenderness values of 6 (moderately tender) and 7 (very tender). Tenderness in Brahman steers ranged from 3 to 5.5. It should be noticed that the downward trend in tenderness from Angus to Brahman is a closer reflection of the upward trend for WB shear force between Angus and Brahman at 5 days than at 14 days postmortem. Thus, WB shear force at 5 days postmortem appears to be a better indicator of tenderness than WB shear force at 14 days postmortem.

Specific Branded Beef Programs

Branded beef programs in the USA could be grouped into two categories depending on whether; 1) they have live requirements (phenotypic or genotypic) and they require animals to have hump heights lower than or equal to 2 inches, and 2) they do not have either live or hump height requirements. Certified Angus Beef (USDA, 2002a) falls into the first category, and Nolan Ryan's All Natural Tender Aged Beef (USDA, 2002b) belongs to the second category. The acceptability of the steer carcasses of the Angus-Brahman multibreed herd will be discussed considering only the deciding factors from each program.

Certified Angus Beef. The most critical conditions of this program are live requirements and hump height. Live requirements (51% black) would exclude all Brahman steers, and hump height requirements (less than or equal to 2 inches) would eliminate 2% Angus, 2% Brangus, 10% ½ Angus, and 61% ¾ Brahman steers. Interestingly, 19% of all Brahman steers had hump heights lower than or equal to 2 inches. Quality grade (prime, choice) and(or) marbling requirements: 500 (modest) and above would eliminate the majority of the remaining carcasses. Approximately 47% Angus, 34% ¾ A, 31% Brangus, 23% ½ A, and 15% ¼ A would be accepted according to these two criteria. When all four criteria (live requirements, hump height, quality grade, and marbling) are considered together approximately 22% of steer carcasses (45% Angus, 32% ¾ A, 29% Brangus, 20% ½ A, and 6% ¼ A; Figure 22) will be accepted. If, in addition, tenderness is included as an additional criterion, and only tender steers (tenderness score 5 and higher) were acceptable, this fraction would drop to 16% (40% Angus, 21% ¾ A, 20% Brangus, 13% ½ A, and 3% ¼ A).

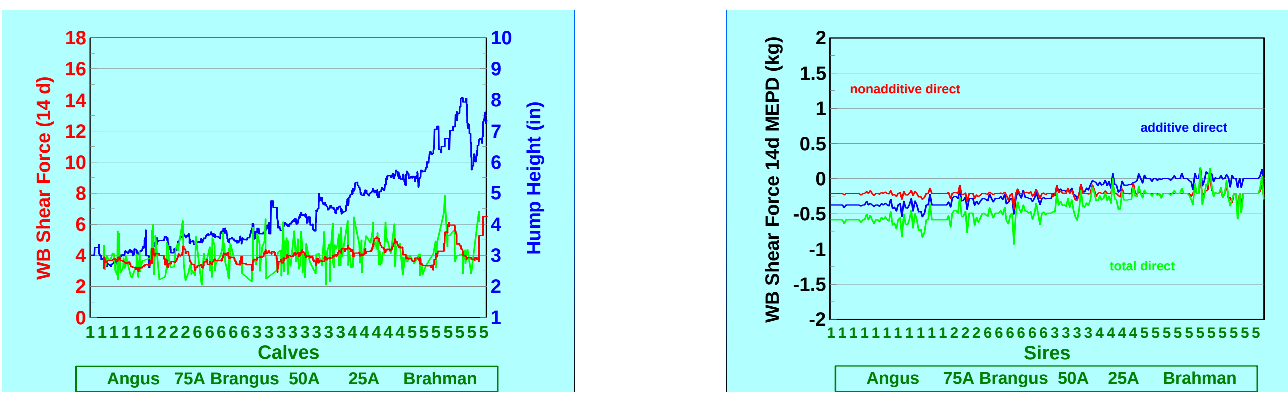

Figure 20. Steer WB shear force at 14 days, moving averages, and sire additive, nonadditive, and total direct multibreed expected progeny differences in the Angus-Brahman multibreed herd.

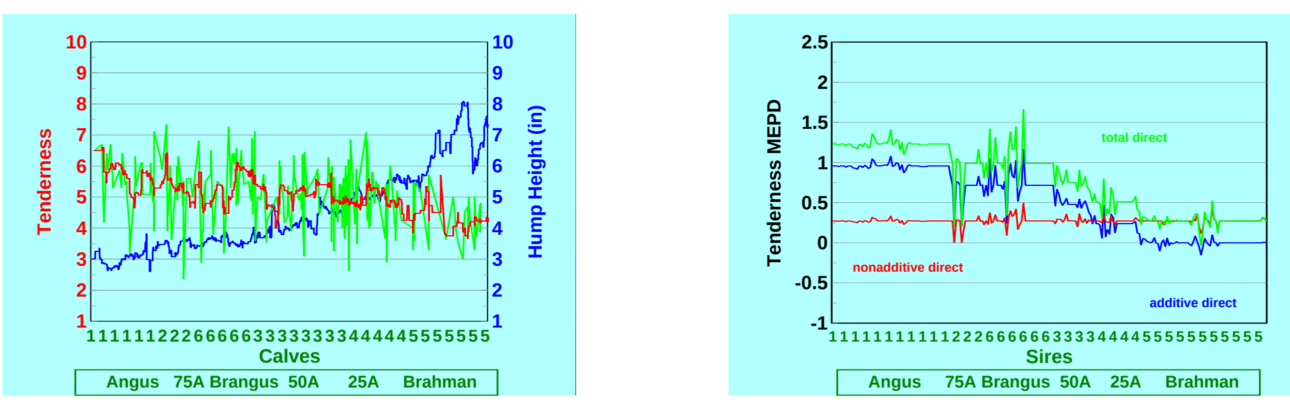

Figure 21. Steer tenderness scores, moving averages, and sire additive, nonadditive, and total direct multibreed expected progeny differences in the Angus-Brahman multibreed herd.

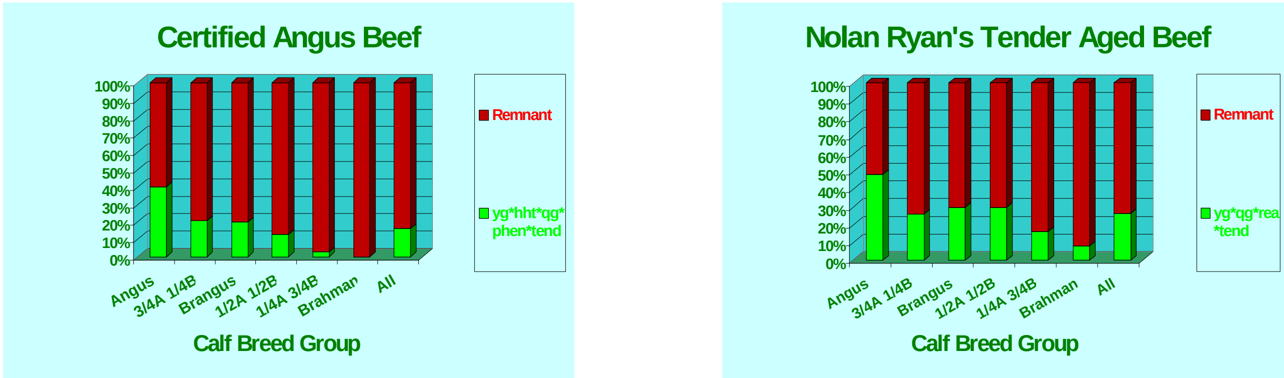

Figure 22. Fraction of acceptable steer carcasses by two branded beef programs in the Angus-Brahman multibreed herd considering phenotypic, hump height, yield grade, ribeye area, quality grade, and tenderness factors.

Nolan Ryan's All Natural Tender Aged Beef. Carcasses from all breed groups can be considered for this program. The crucial requirements are yield grade: 2.9 or less, ribeye area: 11 to 16.5 square inches, and quality grade (choice, select) and (or) marbling: 300 (slight) to 699 (moderate). Considering these requirements, 41% of all carcasses in the Angus-Brahman multibreed data set would have been eligible to participate in this program (54% Angus, 40% ¾ A, 44% Brangus, 47% ½ A, 32% ¼ A, and 30% Brahman). If tenderness is added as a further criterion, and only tender animals were acceptable, then the fraction of acceptable carcasses in the multibreed data set would drop to 26% (48% Angus, 26% ¾ A, 30% Brangus, 30% ½ A, 16% ¼ A, and 8% Brahman; Figure 22). As indicated in the yield grade section above, had animals been slaughtered at a lower backfat endpoint, it is likely that a substantially higher percentage of carcasses would have been eligible to participate in this program.

Implications

The results presented herein indicate that from a growth trait standpoint it is advantageous to use Brahman in cow-calf crossbreeding production systems in Florida. Genetically Brahman sires had generally higher predicted values than Angus, Brangus, and Angus × Brahman sires for direct genetic effects, but the opposite occurred for maternal effects. From the point of view of carcass traits the situation is less favorable to Brahman. Most branded beef programs excluded Brahman and Brahman crossbred calves using primarily specific requirements of phenotype, genotype, and hump height. Results suggest that these two requirements alone would eliminate about 60% of 75% Brahman and all 100% Brahman carcasses. Branded beef programs that impose no restrictions on phenotype, genotype, and hump height will accept all A and B maturity steers that meet their yield grade, quality grade, and ribeye area restrictions. This last type of program might be more rewarding to Brahman crossbred production systems in Florida and the Southern region than breed oriented branded beef programs.

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Appendix

Yield Grade Formula

Yield Grade = (2.5 + {2.5 * Adjusted FOE} + {.20 * KPH} - {.32 * REA} + {.0038 * HCW})

Marbling Codes

Abundant (A) - 900 to 999
Moderately abundant (MA) - 800 to 899
Slightly abundant (SA) - 700 to 799
Moderate (Md) - 600 to 699
Modest (Mt) - 500 to 599
Small (Sm) - 400 to 499
Slight (Sl) - 300 to 399
Traces (T) - 200 to 299
Practically Devoid (D) - 100 to 199

Quality Grade Codes For A And B Maturity

Quality Grade Code	Marbling Required
Prime - 700 to 799	SA^0 - A^{99}
Choice - 600 to 699	Sm^0 - Md^{99}
Select - 500 to 599	Sl^0 - Sl^{99}
Standard - 400 to 499	PD^0 - Tr^{99}
Utility - 300 to 399	
Cutter - 200 to 299	
Canner - 100 to 199	

Scale For Quality Grade

If marbling = 100 - 299, then quality grade = 400 + (marbling - 100)/2

If marbling = 300 - 399, then quality grade = 500 + (marbling - 300)

If marbling = 400 - 699, then quality grade = 600 + (marbling - 400)/3

If marbling = 700 - 999, then quality grade = 700 + (marbling -700)/3

Tenderness Codes

8 - extremely tender
7 - very tender
6 - moderately tender
5 - slightly tender
4 - slightly tough
3 - moderately tough
2 - very tough
1 - extremely tough

Notes: