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Sorting Cattle - A Review

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The value of feeder cattle when purchased is based largely on weight, breed type, and subjective evaluation. However, the true value of feeder cattle over time is the difference derived from carcass value and costs of production. Sorting groups of cattle by a trait results in reducing the variation of the trait sorted. The last 15 years we have focused on the concept of value-based marketing. Carcass value is variable and with a "Grid Pricing System" the opportunity for premiums as well as discounts exists. Costs of feeding are affected substantially by the length of the feeding period and the value of the carcass is affected by the composition of the animal at slaughter. Improvement in the classification of feeder cattle would improve the estimation of subsequent performance of individual feeder animals in groups by the assembly of more uniform outcome groups for feeding. Such a result could increase the value of feeder animals, reduce the costs of production, or both (Butts et al, 1980).

Researchers have reported that it is possible to sort cattle prior to slaughter to improve the uniformity of a portion of the cattle (Tatum et al., 1996a; Dolezal et al., 1995; Trenkle 1997). There will be a portion of the cattle however, which do not garner a premium and may even receive discounts. If cattle are not properly sorted and/or are sold on a grid that doesn't fit them, the discount received may reduce the premiums to the point that selling live would be more profitable.

The purpose of this report is to review the most current concepts of sorting cattle. The reader should be aware that individual feedlot programs and markets will dictate the involvement and extent of sorting and its usefulness.

Costs of Sorting at Market Time

In feedlots, the process of sorting involves several hidden costs that have only been addressed by one author in the literature. Stanton (1997) addressed the implications of reworking cattle and sorting to target a specific market may have.

Lost Yardage. Loss of yardage is a substantial loss that can cost feedlot operators or owners who custom feed cattle in lots. For example (Table 1) a 300 head pen of cattle fed for 100 d returns $7500 dollars to the feedlot at .25/hd/d or $525.0/week. If after 100 days one load is sorted out every week for the next 6 weeks, the net result is a loss of $1560.25 or 5.20/hd. Who will pay the loss in yardage? Will custom lots have to increase yardage or will yardage be considered on a per pen basis, if producers wish to have their pens of cattle "topped off". Delaney (2001) reported that the number one priority of feedlots is to manage occupancy. The author also stated that the two largest potential operating expenses within a feedyard are underutilized capacity and labor.

Equipment/Labor. Sorting strategies will require the use of a chute and extra labor. Some commercial feedlots will charge a 1.00/hd to run animals through the chute. If additional equipment and people are used, such as an ultrasound machine and technician, the cost may reach as high as 10.00/head.

Lost Performance. Producers must be aware of the limitations of their facilities and the stress that this can have on cattle. Reworking cattle can have a negative effect on average daily gain (ADG) (Stanton, 1997). Stanton, 1997 reported that average daily gain was reduced 5.6% and feed efficiency was 6.9% poorer.

Do cattle that are sorted for market react in the same way once they are returned to the pens? A hidden cost is the phenomenon of co-mingling cattle. Cattle behave differently when mixed with new cattle or are moved into different sized groups. Feed intakes of newly mixed cattle or pens that have been topped off may be substantially different than what is expected. Too often feed deliveries are cut back based on the average intake of the pen when in reality the

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cattle that may have been removed were the faster gaining cattle with higher intakes. If this happens too much feed may be delivered and consequently the remaining cattle may experience some type of metabolic disorder. The loss of one steer in a pen of cattle may off set the value gained by sorting. More research in this area must be done.

Costs of Slower Gaining Cattle. A cost which is often overlooked is the cost of owning the slower gaining cattle longer. The cattle that are marketed first are faster gaining, and when they are removed, the average performance of the pen decreases dramatically. Stanton (1997) divided 62 steers that had been individually fed for 147 d into a top, middle and bottom weight group (Table 2). Steers in the top weight group ate 12% more dry matter and gained 20% more than the bottom third. The author calculated that it would take one month longer for the bottom third of the pen to equal off-test weight of the middle group. Sorting out the best performing, most efficient cattle early in the feeding period and retaining cattle that aren't as efficient is an indirect cost to the cattle owner.

Factors Affecting Cattle

Background. Breed type, weight, condition, frame, and sex have been continuously studied over the last 70 years. (Knox and Kroger, 1946; Reid et al., 1968; Cundiff et al., 1993). Prior to the 1960's, cattle were of primarily British breed descent with U.S. cattlemen only utilizing five breeds of cattle. It wasn't until the late 60's and early 70's that the influence of different breeds added greater variety in biologial type. By 1970, 32 breeds of cattle were being used extensively in breeding programs in the U.S. However, it is important to note that variation does exist within a given breed (Wheeler et al., 1996). Sorting groups of cattle by a trait results in reducing the variation of the trait sorted. Variation is reduced primarily because outliers are removed when cattle are grouped according to the traits of priority. Outliers can be cattle or carcasses that receive discounts and reduce the overall profitability of the group. In our current market system of selling cattle for commodity trade, the reduction of YG 4's, overweight carcasses, and standards can improve the gross value of a load of cattle dramatically.

Breed/Biological Type. Effects of various breeds and their biological type have been studied in depth by researches (Fortin et al., 1980; Eversole et al., 1981; Wheeler et al., 1996). The results of using slow growing, early maturing cattle are carcasses that have excess fat and low cutability. Conversely, extremely fast-growing, late-maturing cattle tend to be lean and have high cutability. A rapid increase in growth can be advantageous in producing more retail product but can have negative effects on intramuscular fat as well as fertility, calving ease, and mature size. In a classical report Cundiff et al. (1993) summarized the performance of F_1 calves from 26 sire breeds. The breeds were ranked by their ability to perform in four areas: 1) Growth rate/mature size; 2) Lean to fat ratio; 3) Age at puberty; and 4) Milk production. The data categorized the breeds into 7 different biological types (Table 3). No one breed excels in all economically important traits because of the antagonistic relationship that exits (Bruns 1994). The utilization of crossbreeding allows the producer to complementarily match breeds for specific market targets without sacrificing production efficiency. A greater number of producers are switching breeding programs to straight-bred programs in an effort to capitalize on uniformity and breed demand. Bruns (2000) summarized data of finishing steers from two sources (Ranch C n=159; Ranch W n=151) in an effort to quantify variation within a producer's calf crop. Group C were crossbred cows (Continental and British breeds) mated to Continental bulls and Ranch W were Limousin and Angus bulls used on Angus cows. Table 4 reports the mean weight and the standard deviation from the mean for each group. Between the two sources of steers there is little difference in the standard deviations for carcass traits. The data would suggest that herds of the same breed origins are not necessarily more uniform when compared to other breeds but that cattle from similar biological types may have similar degrees of variation. Understanding biological type and how crossbreeding complements two different types of cattle is beneficial when sorting cattle relative to outcome groups.

Age. Age of cattle is an important factor for sorting purposes to better-fit cattle to nutritional needs and marketing outcome groups. More importantly under the current USDA Beef Cattle Grading Standards (USDA, 1997) cattle that are B-maturity and do not obtain marbling scores of modest or higher are graded USDA Standard. Delaney (2001) reported that carcasses that are graded as “hard bones” reflect a price discount of $246.00 per head equivalent to a reduction of feeder calf value of $35.00 /cwt. The effect of age on carcass traits has been reported in an effort to quantify changes in carcass composition (Colemen and Evans., 1986; Tatum et al., 1986a; Dolezal et al., 1995). Cattle are often subclassed by age in to three groups: 1) calves – cattle that are weaned and started on a finishing ration less than 10 mo. of age; 2) short yearling – cattle that are backrounded for a period of time and started on feed less than 14 mo. of age; and 3) long yearlings – cattle that are backgrounded for an extended period of time and started on feed at ages greater than 14 mo. Dolezal et al., (1995) classified feeder cattle relative to the USDA Grades of feeder cattle (1979) and studied the effect of age (calf-fed, short-yearling, and long-yearling) in relation to carcass traits when cattle were harvested at a constant backfat endpoint. The author reported that cattle started on feed at a younger age had greater days on feed (DOF) with lighter carcass weight than short yearlings and long yearlings. Across frame size and muscle score groups long yearling cattle had greater percentages of carcass fat with the greatest proportion being found in the intermuscular depot. The author concluded that age had a significant effect on DOF and harvest weight at a constant fat endpoint. Classifying cattle by age is important in determining DOF and optimum endpoints. It is important to note that age, irresponsive of frame size, is positively correlated to increased weight and carcass fatness. Successful identification of age groups in feeding situations would aid in the determination of DOF and projected endpoint.

Frame size. Frame size can be subjectively evaluated with ease. Researchers (Brown et al., 1973; Tatum et al., 1986a) have documented that height at a given age is positively correlated to mature size. Mature size is inversely related to rate of maturity. When comparing cattle of similar age, but different frame sizes, small-framed cattle are more advanced in their degree maturity and thus have a higher degree of fatness when compared to large frame cattle. Research investigating the outcome of USDA feeder cattle grades (1979), Tatum et al., (1986b) and Dolezal et al., (1995) reported that larger framed cattle, when harvested at similar DOF were heavier and had less condition that their small-framed contemporaries. Trenkle (2001) sorted cattle by frame score into two groups (small framed, SF; large framed, LF) (Table 5). Large frame steers tended to have heavier final weights with less backfat and larger ribeye area. Smaller framed steers consumed less feed (P<.01) and had improved (P<.10) feed efficiency. The data would indicate the opportunity for alternative feeding and marketing strategies for cattle differing in frame size.

Fat thickness/condition score. Extensive research has been conducted on the initial degree of fatness of calves, or on the subsequent relationship to carcass fatness (Butts et al., 1980; Houghton, 1988; Smith et al. 1989; Delehant et al., 1997; Trenkle and Iiams, 1997; Loy et al., 1998). The use of ultrasound to estimate carcass traits has aided greatly in this endeavor. Trenkle and Iiams (1997) sorted crossbred steers into low or high initial ultrasound backfat groups at the start of the trial. After a 158 d on feed carcass data was collected. Steers that were assigned to the low backfat group had an increased percentage of yield grade 1 and 2 carcasses (79% vs 50%). Trenkle (2001) reported that initial ultrasound backfat depth is related to carcass back fat. (Table 5) Condition scoring (CS) has been successfully used as an alternative to ultrasound to classify cattle into outcome groups (Loy et al, 1998)(Table 6). Cattle were visually appraised and assigned a CS from 1 – 9. Cattle with higher initial CS had heavier initial weights, required fewer days on feed and had greater fat thickness at harvest. Sorting calves by condition score/backfat could be useful for adjusting dry matter intake NRC (1996). Calves that are fleshier may have greater DMI while animals with less backfat should have a greater compensatory gain potential.

Muscle thickness/score. Extensive work has been conducted to study the effect of muscle shape on carcass composition (Kauffman et al., 1973; Butts et al., 1980; Tatum et al., 1986a; Tatum et al., 1986b; Dolezal et al., 1995). Research would suggest that the largest differences in muscle-to-bone ratios are found between beef and dairy breeds of cattle (Berg and Butterfield, 1968, Broadbent et al., 1976). Kauffman et al., (1973) and Tatum et al., (1986a) concluded that differences in muscle thickness classification can reflect the inherent variation in muscularity and muscle-to-bone ratios. Dolezal et al., (1995) reported that thinly muscled cattle may be perceived incorrectly because they deposit high percentages of intermuscular fat. There is disagreement on the affect of muscle score on rate of growth. Dolezal et al., (1995) reported that thinly muscled cattle required the most time on feed and had the heaviest weights to reach the desired compositional endpoint, where as Tatum et al., (1986b) reported no difference in the linear rate of growth between muscle classification groups within a given Frame Size.

Ribeye area is an excellent indicator of the amount of muscle in a carcass and the use of ultrasound in quantifying the difference between animals at slaughter has been well proven (Houghton and Turlington, 1992; Herring et al., 1994). The use of initial ultrasound REA measurement to quantify differences in muscularity has also been studied with limited success (Butts et al., 1980; Smith et al., 1989; Trenkle and Iiams, 1997). Research (Smith et al., 1989; Trenkle and Iiams, 1997) has reported that steers with larger initial ribeye area measurements produced carcasses at harvest with correspondingly larger ribeyes. Smith et al., (1989) reported that this relationship was greater in steers that had heavier initial starting weights. It is certainly evident that when sorting cattle on initial ribeye area that initial weight aids greatly in explaining the variation between cattle.

Weight/performance. Weight has long been the primary factor as to how producers, sale barns and feedlots sort calves. In research results mentioned previously weight has been reported to be related to frame, backfat and muscling (Tatum et al., 1986a, 1986b; Trenkle and Iams 1997; Trenkle, 2001). Angus steers (n = 475) were sorted by initial weight into three evenly divided weight groups; heavy 341 kg, medium 319 kg, light 298 kg. The heavy group accounted for 4.6% of the total amount of YG 4's. Yield grade was significantly different between groups with the heavy group having heavier initial weights and higher YG's. However, the heavy group of cattle, with the most backfat, did not have the greatest percentage of carcasses grading choice and higher. Should cattle that perform slowly during the backgrounding phase be sorted off because their subsequent performance will be impaired? Cattle were identified as poor performers if their ADG was one standard deviation below the mean ADG at the end of the backgrounding phase. The data (Table 7) would suggest just because cattle gained slowly during the backgrounding phase does not imply that the same cattle will be poor performers throughout the feeding phase.

Source/calf origin. Cattle producers have increasingly become more aware of the value of effectively identifying source. Source/calf origin encompasses all of the fore mentioned topics. A study was conducted at the SDSU Feedlot research center which utilized 476 head of Angus, Angus cross steers purchased from four producers from West River SD. These steers had an initial weight of 319 kg with a range from 264 to 375 and a standard deviation of 19.8 (Table 8). Source did reveal a difference in the percentage of yield grade 4's (YG) (Table 8). Even though Source 1 had the greatest percentage of YG 4's it still had a higher total value per head, when priced on a traditional grid, than Source 4 because of greater carcass weight. Data on the morbidity rates of the sources reveals that source has a major impact.

Systems to Predict Optimum Endpoints

Ultrasound. Research has been done for the last 20 years trying to improve the accuracy and repeatability of ultrasound. Ultrasound is now being used to sort cattle into similar groups, however cattle may or may not be similar at the end of the finishing period (Iiams & Trenkle, 1997). A trial conducted by Delehart et al (1997), described a method of carcass prediction equations by using real-time ultrasound. One hundred twelve British-cross yearling steers with an average weight of 750 lbs. were utilized. All cattle were individually scanned for BF, REA and IMF every 28 days to establish prediction equations. Parameters describing backfat development were calculated. Backfat per 100 lbs. of body weight had the highest R^2 value for ending ribfat (.81) however body weight accounted for a similar amount of the variation with an R^2 value of .80. Brethour (2001) reported that at the present level of accuracy 75% of feeder cattle can be identified as to their potential to grade Choice or not. The author also reported that it is seldom possible to make backfat projections on incoming cattle because they most often have no measurable back fat thickness. It is necessary to have cattle begin the fattening process so differences can be detected.

Electronic Cattle Management. Researchers and industry personnel have focused on developing a system, which effectively sorts and identifies cattle to target market endpoints. Fox et al. (1992) and Tylutki et al. (1994) developed a system to predict the energy requirements of cattle, which was adopted by NRC (1996). Perry and Fox (1997) developed prediction equations for carcass composition and individual feed requirements for fed cattle. These systems were used to develop an Electronic Cattle Management sorting and tracking system (ACCU TRAC^{TM}; Microchemicals, Inc., Amarillo, TX) which is described by Fox (1996) and Cravey (2001). The ECM predicts carcass and empty body weight composition so incremental costs of gain as well as quality and yield grade can be predicted. An optimal sale point is determined to maximize profitability. During processing, cattle are measured for weight, frame size by video imaging, and ultrasound for backfat depth. The system will then assign them to one of six pens. During the initial measurement the system typically groups the cattle into an early or late maturing group (Cravey, 2001). After 75 DOF, or at re-implant time, the cattle are re-measured and sorted into specific market outcome groups. At harvest all carcasses are individually measured for HCW, BF, and REA. The data is combined with feedlot performance data and provided to the owner.

Management. Delany (2001) described an effective system used at Friona Industries, L.P. Feedlot managers sort cattle based on visual and production data indicators as to how they may fit certain fed cattle pricing grids. Sorting can be effectively done during four phases of production: 1) point of purchase; 2) point of placement; 3) during the feeding period (reimplant time); and 4) point of sale. Managers are trained to sort cattle with the two goals in mind; 1) sort by priority to minimize carcass discounts; and 2) sort by grid intentions to maximize premiums. Profitability can be greatly enhanced by matching cattle to management and implant programs that fit their genetic ability. This philosophy has worked extremely well at eliminating outlier cattle. The program also resists the urge to over sort for purposes of inflating the grid price of cattle, which may cause the overall sale price of the pen to suffer.

Summary

Sorting cattle during the finishing phase can be beneficial if outcome groups are properly identified. At this time there is no foolproof method of properly identifying the cattle that may become outliers. The use of simple cost effective methods can prove beneficial in eliminating non-conformers. Properly identifying source, breed, age, frame, and condition score will help establish the future outcome of the cattle received. The use of ultrasound and other technical methods has shown to properly identify cattle that may be outliners. Visual and/or measured traits of feeder cattle do not address the effects of animal age or health and nutritional history on their future growth and performance. Sorting programs need to be more than just the quantifications of an individual animal's traits. Previous research would indicate that source of origin plays an important role in the management and marketing of calves. Information feedback may be as useful to the producer to quantify traits (morbidity, mortality, genetics) that economically make an impact on the profitability of a pen.

Literature Cited

Broadbent, P. J., C. Ball, and T. L. Dodsworth. 1976. Growth and carcass characteristics of purebred and crossbred cattle with special reference to their carcass lean:bone ratios. Anim. Prod. 23:341.

Berg, R. T. and R. M. Butterfield. 1976. New concepts of Cattle Growth. Univ. of Sydney Press, Sydney.

Brethour, J. R. 2001. Technology for pre-harvest evaluation of fed cattle – ultrasound. P 37 in Proc. Plains Nutrition Council Spring Conference. Publ. No. AREC 01-23. Texas A&M.

Brown, C. J., J. E. Brown, and W. T. Butts. 1973. Evaluating relationships among immature measures of size, shape and performance of beef bulls. II. The relationships between immature measures of size, shape and feedlot traits in young beef bulls. J. Anim. Sci. 36:1021.

Bruns, K. W. 2000. Sorting for different markets – costs versus benefits. Advanced feedlot cattle management shortcourse II. July 10-13, 2000; Brookings, SD.

Bruns, K. W. 1994. Correlated response in growth, reproduction, and maternal traits to selection for carcass and meat traits in beef cattle. P 279 in Proc. Beef Improvement Federation Research Symposium and Annual Meeting, Des Moines, IA.

Butts, W. T., Jr., W. R. Backus, E. R. Lidvall, J. A. Corrick and R. F. Montgomery. 1980. Relationships among definable characteristics of feeder calves, subsequent performance and carcass traits. I. Objective measurements. J. Anim. Sci. 51:1297.
Coleman, S. W. and B. C. Evans. 1986. Effect of nutrition, age and size on compensatory growth in two breeds of steers. J. Anim. Sci. 63:1968.
Cravey, M. 2001. A review of ACCU-TRAC: A technology System for pre-harvest management of fed cattle. In: Proc. Plains Nutrition Council Spring Conference. Publ. No. AREC 01-23. Texas A&M.
Cundiff, L. V., F. Szabo, K. E. Gregory, R. M. Koch, M. E. Dikeman, and J. D. Crouse. 1993. Beef comparisons in the germplasm evaluation program at MARC. Proc. Beef Improvement Federation Research Symposium and Annual Meeting, Asheville, NC. P. 124.
Delaney, D. 2001. Managing and targeting fed cattle for carcass-based vs. live based marketing. In: Proc. Plains Nutrition Council Spring Conference. Publ. No. AREC 01-23. Texas A&M.
Delehant, T. M., G. R. Dahlke, M. P. Hoffman, J. C. Iiams, G. H. Rouse, D. E. Wilson. 1997. Using real-time ultrasound during the feeding period to predict cattle composition. 1997 Iowa State Univ. Beef Research Report. A.S. Leaflet R1433.
Dolezal, H. G., J. D. Tatum, and F. L. Williams, Jr. 1995. Effects of feeder cattle frame size, muscle thickness, and age class on days fed, weight, and carcass composition. J. Anim. Sci. 71:2975.
Eversole, D. E., W. G. Bergen, R. A. Merkel, W. T. Magee and H. W. Harpster. 1981. Growth and muscle development of feedlot cattle of different genetic backgrounds. J. Anim. Sci. 53:91.
Fortin, A., S. Simpfendorfer, J. T. Reid, H. J. Ayala, R. Anrique, and A. F. Kertz. 1980. Effect of level of energy intake and influence of breed and sex on the chemical composition of cattle. J. Anim. Sci. 51:604.
Fox, D. G. 1996. Predicting optimum endpoints for finishing cattle. In: Proc. The Composition of Growth in Beef Cattle in honor of Rodney L. Preston, Ph.D. Dept. of Animal Science and Food Technology, Texas Tech Univ. Lubbock.
Fox, D. G., C.J. Sniffen, J. D. O'Connor, J. B. Russell, and P. J. Van Soest. 1992. A net carbohydrate and protein system for evaluating cattle diets: III. Cattle requirements and diet adequacy. J. Anim. Sci. 70:3578.
Gill, D. R., J. J. Martin, F. N. Owens, and D. E. Williams. 1983. Implants for feedlot bulls. Okla. Agric. Exp. Sta. Publ. MP-114.
Herring, W. O., S. E. Williams, J. K. Bertrand, L. L. Benyshek, and D. C. Miller. 1994. Comparison of live and carcass equations predicting percentage of cutability, retail product weight, and trimmable fat in beef cattle. J. Anim. Sci. 72:1107.
Houghton, P. L. 1988. Application of ultrasound in commercial feedlots and beef breeding programs. P 89 In Proc. Beef Improvement Federation, Albuquerque, NM.
Houghton, P. L. and L. M. Turlington. 1992. Application of ultrasound for feeding and finishing animals: A review. J. Anim. Sci. 70:930.
Kauffman, R. G., R. H. Grummer, R. E. Smith, R. A. Long, and G. Shook. 1973. Does live-animal and carcass shape influence gross composition? J. Anim. Sci. 37:1112.
Knox , J. H. and M. Koger, 1946. A comparison of gains and carcasses produced by three types of feeder steers. J. Anim. Sci. 5:331.
Loy, D. D., S. P. Greiner, G. H. Rouse, D. Maxwell. 1998. Evaluation of condition scoring of feeder calves as a tool for management and nutrition. 1998 Iowa State Univ. Beef Research Report. A.S. Leaflet R1538.
NRC. 1996. Nutrient Requirements of Beef Cattle (6^{th} Ed.). National Academy Press, Washington, DC.
Owens, F. N., D. R. Gill, D. S. Secrist, and S.W. Coleman. 1995. Review of some aspects of growth and development of feedlot cattle. J. Anim. Sci. 73:3152.
Perry, T. C., and D. G. Fox. 1997. Predicting carcass composition and individual feed requirement in live cattle widely varying in body size. J. Anim. Sci. 75:300.
Reid, J. T., A. Bensadoun, L. S. Bull, J. H. Burton, P. A. Gleeson, I. K. Han, Y. D. Joo, K. E. Johnson, W. R. McManus, O. L. Paladines, J. W. Stroud, H. F. Tyrell, B. D. H. Van Niekerk, and G. W. Wellington. 1968. Some peculiarities in the body composition of animals. In: Body Composition in Animals and Man. National Academy Sciences, Washington p. 19-44.
Smith, M. T., J. W. Oltjen, D. R. Gill, H. G. Dolezal, J. R. Kropp, C. A. McPeake, and B. D Behrens. 1989. Ultrasound and visual appraisal as methods to account for variation in performance and carcass parameters in feedlot steers. Okla. Agric. Exp. Sta. Publ. MP-127.

Stanton, T. L., 1997. Costs of reworking cattle. Symposium: Impact of Implants on Performance and Carcass Value of Beef Cattle. Okla. Agric. Exp. Sta. Publ. P-957.
Tatum, J. D., F. L. Williams, Jr. and R. A. Bowling. 1986b. Effects of feeder-cattle frame size and muscle thickness on subsequent growth and carcass development. I. An objective analysis of frame size and muscle thickness. J. Anim. Sci. 62:109.
Tatum, J. D., H. G. Dolezal, F. L. Williams, Jr., R. A. Bowling, and R. E. Taylor. 1986a. Effects of feeder-cattle frame size and muscle thickness on subsequent growth and carcass development. II. Absolute growth and associated changes in carcass composition. J. Anim. Sci. 62:121.
Trenkle, A. H. 2001. Effects of sorting steer calve on feedlot performance and carcass value. 2001 Iowa State Univ. Beef Research Report. A.S. Leaflet R1740.
Trenkle, A. H. and J. C. Iiams. 1997. Potential value of ultrasound to sort feeder cattle into more uniform groups for finishing and marketing. 1997 Iowa State Univ. Beef Research Report. A.S. Leaflet R1432.
Tylutki, T. P., D. G. Fox and R. G. Anrique. 1994. Predicting net energy and protein requirements for growth of implanted and nonimplanted heifers and steers and nonimplanted bulls varying in body size. J. Anim. Sci. 72:1806.
USDA. 1979. Official United States Standards for Grades of Feeder Cattle. Agric. Marketing Service, USDA, Washington, DC.
USDA. 1997. Official United States Standards for Grades of Carcass Beef. Agric. Marketing Service, USDA, Washington, DC.
Wheeler, T. L., L. V. Cundiff, R. M. Koch, and J. D. Crouse. 1996. Characterization of biological types of cattle (Cycle IV): Carcass traits and longissimus palatability. J. Anim. Sci. 74:1023.

Tables

Table 1. Costs – Yardage[1]

	Sorted pen	Full pen = 300 hd	Lost yardage
300 hd x 100 d x $.25 =	$7500.00	$7500	$ 0
257 hd x 7 d x $.25 =	449.75	525	75.25
214 hd x 7 d x $.25 =	374.50	525	150.50
171 hd x 7 d x $.25 =	299.25	525	225.75
128 hd x 7 d x $.25 =	244.00	525	301.00
85 hd x 7 d x $.25 =	148.75	525	376.25
42 hd x 7 d x $.25 =	73.50	525	451.50
Total	$9,089.75	$10,650	$1,580.25

[1]Adapted from Stanton (1997).

Table 2. Individual steer performance[a]

Item	Top	Middle	Bottom
No. steers	21	21	20
End wt., kg	655	617	575
ADG, kg	1.98	1.82	1.58
Feed intake, kg	9.0	8.3	8.0
Feed/kg gain, kg	4.55	4.55	5.08
Hot carcass wt., kg	403	378	351
Yield grade	2.32	2.27	2.47
% Choice	59	59	53

[a]Adapted from Stanton (1997).

Table 3. Breeds grouped by biological type[ab]

	Growth rate and mature size	Lean to fat ratio
Low growth rate	X	XX
Moderate growth rate	XXX	XXX
Bos Indicus influence	XXX	XX
High growth and maternal	XXXX	XXXX
High lean/low fat ratio	XXXX	XXXXX

[a] Adapted from Cundiff et al. (1993).
[b] Increasing numbers of x’s indicate relatively higher rate.

Table 4. Standard deviations for carcass traits by source

	Ranch C	Std	Ranch W	Std	SEM
End wt, kg[a]	539	47	541	45	3.76
DP[b]	62.5[f]	1.6	61.9[g]	1.5	0.12
HCW, kg	337	31	335	30	2.3
Fat depth, cm	1.51	.37	1.51	0.38	0.031
Ribeye area, cm^2	81.5	7.5	81.4	6.7	0.55
Yield grade[c]	3.26	.59	3.19	0.58	0.047
Marbling score[d]	5.40[f]	.79	5.61[g]	0.88	0.066
Shear force, kg[e]	4.13[f]	.83	3.91[g]	0.78	0.065

[a] Final BW shrunk 4%.
[b] Hot carcass weight/shrunk (4%) final BW.
[c] Calculated by formula.
[d] 4.0 = Slight°; 5.0 = Small°.
[e] Measured by Warner Bratzler Shear Force.
[f,g] Means differ ($P < 0.05$).

Table 5. Effects on feedlot performance and carcass merit of sorting feeder calves based on initial frame score and backfat[a]

	- - - Frame[b] - - -		- - - Backfat[c] - - -		- - - - - - P[d] - - - - - -		
	SF	LF	Less	More	Frame	Backfat	FxBF
Initial hip ht, in.	42.1	44.0	43.0	43.1	0.001	0.73	0.85
Starting wt, lb	477.5	542.5	499.2	520.8	0.01	0.41	0.78
Frame score	4.1	5.0	4.5	4.6	0.001	0.95	0.88
Initial backfat, in	0.080	0.085	0.062	0.103	0.22	0.001	0.72
Initial ribeye area, in^2	6.07	6.68	6.19	6.56	0.01	0.13	0.81
Final hip height, in	49.5	50.9	50.3	50.1	0.001	0.52	0.92
Final wt, lb	1,157.7	1,245.7	1,206.4	1,197.1	0.001	0.62	0.92
Days fed	190.4	191.2	193.5	188.2	0.71	0.02	0.80
Gain, lb/d	3.53	3.63	3.62	3.55	0.01	0.10	0.12
Feed intake, lb DM/d	18.6	19.8	19.2	19.3	0.001	0.68	0.62
Feed/gain	5.29	5.47	5.30	5.45	0.09	0.18	0.59
Carcass wt, lb	720	775.1	752.1	743.2	0.001	0.53	0.81
Dressing %	62.3	62.3	62.4	62.2	0.91	0.49	0.78
Marbling score[e]	435	425	425	435	0.29	0.25	0.46
Backfat, in	0.46	0.43	0.40	0.49	0.13	0.001	0.48
Ribeye area, in^2	12.4	12.9	12.7	12.6	0.001	0.79	0.24
Calculated yield grade	3.11	3.14	3.08	3.17	0.75	0.20	0.61

[a]Adapted from Trenkle (2001).
[b]Frame score calculated from hip height, SF = smaller frame; LF = larger frame.
[c]Backfat measured with ultrasound, L = less; M = more.
[d]P is the probability of statistical difference due to main effects of sorting based on initial frame score and backfat and interaction of frame score and backfat. $P < 0.05$ is statistically significant.
[e]300 = Slight°; 400 = Small°; 500 = Modest°; 600 = Moderate°.

Table 6. Effect of condition score on performance and carcass traits[a]

Item	Condition Score 4.4	5.1	5.6	Linear effect of CS
Initial weight, lb	619	651	663	< 0.03
ADG	3.66	3.53	3.69	NS
Days on feed	185	180	178	< 0.07
Carcass weight, lb	754	758	772	NS
Fat thickness	0.48	0.53	0.61	< 0.05
Ribeye area	12.4	12.9	12.6	NS
KPH, %	2.2	2.2	2.2	NS
Yield grade	3.02	3.03	3.36	< 0.09
Marbling score[b]	1041	1046	1035	NS

[a]Adapted from Loy et al., (1998).
[b]Marbling score 1000 = Small°.

Table 7. Backgrounding performance

Received	Head	Starter Days	Total Days	Slow starters that were slow finishers
Jan	119	63	117	6 of 16
Nov	118	44	230	3 of 13
Nov	113	41	252	1 of 17

Table 8. Performance and carcass data by source

	Source 1	2	3	4	Mean
Head	79	140	172	85	
In Wt	741[a]	710[b]	691[c]	688[c]	704
HCW	755	731	722	709	728
Backfat	0.69[a]	0.60[b]	0.54[c]	0.60[b]	0.59
YG	3.6[a]	3.3[b]	3.0[c]	3.4[b]	3.3
% Ch (pop source)	11/66	23/77	24/65	14/80	72
YG 4's, %	3.6	1.9	.8	1.7	8%
YG 4's/source, %	21.5	6.4	2.3	9.4	
ADG, lb	3.35	3.35	3.29	3.27	3.33
Price/cwt	60.99[a]	63.39[b]	63.18[b]	62.31[d]	63.41
Value $/hd	742.00	751.09	740.08	724.59	796.29
% deads	0	.007	2.5	0	1.25

[a,b,c,d]Means with different superscripts P < 0.01.