Quality grade continues to generate largest grid premiums

Recipe For Marbling

By Brian Bertelsen, Director of Field Operations

Quality grade consistently generates the greatest premium on U.S. Premium Beef grids. Our producers have used their carcass data to improve the quality of their cattle. Yet, given the economic importance, many producers ask how they can further improve their results.

Below is a list of factors that have been shown to affect marbling. Please remember these factors pertain only to marbling. Many of these practices will also affect important things such as cost of gain. This is not meant to be a discussion for net profit. Instead, it is simply a review of factors for producers who still want, or need to increase marbling in their cattle.

1. Genetics determine the animal's genetic *potential*. No animal can be better than its genetic *potential*. Yet, no animal ever reaches its true genetic potential due to environment and management limitations.

Heritability is the genetic measurement of the variation in phenotype (what is observed) that is due to genetics. Carcass traits are highly heritable, so selection pressure will result in changes in phenotype.

The value for marbling in the Angus breed is 0.45, which means genetics account for 45% of the variation in phenotype. However, that implies 55% is due to something else, primarily environment and management. The bottom line is that genetics are important, but the environment and the way the animal is managed have a very big effect on how close an animal will come to expressing its true genetic potential.

Selecting bulls with higher marbling Expected Progeny Differences (EPD) works and the results continue to increase as daughters of those bulls are retained and then bred again to high marbling EPD bulls for the next generation. Artificial Insemination (AI) using highly proven bulls with high accuracy EPD's is the best way to make the most rapid improvement in marbling genetics. Using sons of those high accuracy sires is the next best approach. See USPB Qualified Seedstock Supplier (QSS) breeders listed on the USPB website at www.uspremiumbeef.com for your bull needs.

2. Continental and/or Brahman breed influence should be managed. It is true there is a great deal of variation within each breed. This means there are some Continental breed individuals that are better than some English breed individuals. However, when comparing entire breeds, there is still a significant difference between breed averages with English breeds having an advantage in marbling.

Another consideration is **breed composition variation** within a calf crop, or more importantly, within a feedlot pen. If you are going to crossbreed your cattle, feeding some 50% Continental steers together in the same pen with some 100% English heifers is a real challenge even with extensive sorting. Consider either crossing ALL cattle with the same breeds or use composite or F-1 bulls to limit the difference in breed composition.

3. Temperament can also be used in selection and culling. The Tri-County Steer Futurity in Iowa and other reports have shown that docile cattle grade better than wild or excitable ones. Some research has even shown that one wild animal can limit the performance of its pen mates.

4. Shorten the calving season to create more uniform feeding groups. This should facilitate harvesting more cattle closer to their optimum body fatness of a Yield Grade 3. There will also be fewer cattle that "fill out a load" that are under or over fed. This is especially helpful in small herds.

University of Nebraska research found that calves born in the first 21 days of the calving season graded 10% greater USDA Choice and 15% greater upper 2/3 Choice (the marbling requirement for CAB) with 45 pounds more carcass weight resulting in significantly more valuable carcasses.

Estrus synchronization can allow more cows to be bred at the start of the breeding season. Coupled with AI, it can produce calves with more uniform age and superior genetics.

5. Manage cow nutrition. University of Nebraska research has demonstrated a fetal programming effect on calves during gestation, where supplementation of cows grazing winter range or cornstalks with just one pound per day of a 28% distillers based cube during the last trimester increased percent Choice by 23% and upper 2/3 Choice by 20% in steer calves at harvest. The nutrition of the cow this winter can profoundly affect the marbling of the unborn calf that will calve next spring and then harvest over a year later.

6. Start a calf's immune system with colostrum. Health/disease has a very profound effect on marbling. Start the calf off right with a healthy dose of colostrum to create "passive" immunity in the calf from its mom. The quality of colostrum can be affected by the cow's health status so it is important to have your entire herd on a good health program.

7. Vaccinate to assist in prevention of disease. Immunity helps prevent infection from bacteria and viruses. A good, sound vaccination program for the whole herd will allow calves to grow and marble closer to their genetic potential. Sick cattle not only demand more calories for their immune system, but they also eat less feed and consume less calories, so marbling deposition effectively shuts down.

But remember, vaccination does not equal immunity. Handle vaccines with care to maximize effectiveness. Syringe sterilization methods and sunlight exposure can affect vaccine efficacy. Properly control temperature of vaccines during storage and administration. Avoid administering during times of high stress like weaning, shipment or severe weather. Always use the proper injection method, intramuscular or subcutaneous, and observe Beef Quality Assurance guidelines for injection sites.

8. Provide adequate mineral nutrition. Many ranches are located in geographic areas that are deficient in several key minerals like selenium or copper, for example. Adequate minerals help the immune system function, not only to fight off disease, but also to adequately react to vaccinations and build effective immunity.

Consider the absorption of different forms of minerals. For example, chelated minerals may be more readily absorbed. They may be effective, especially during key periods of the production cycle, during stress or during vaccination.

9. Castrate male calves early in life. Research has long proven that delaying castration of male calves past the age of weaning can decrease marbling and Quality grade.

10. Creep feed calves before weaning. Not only can it add pounds and improve adaptation to grain-based finishing diets, but it can also start the deposition of marbling at an early age. Perhaps even more importantly, feeding grain, especially corn, to calves at approximately nine months of age or earlier has been shown to create more fat cells that will store excess calories as marbling fat. This augments the

animal's natural genetic ability for marbling and also appears to "pull" stored calories from external backfat to marbling.

11. Fenceline wean to reduce the stress of weaning. This practice requires adequate facilities and pasture layout, but has been shown effective in making a less stressful transition for the calf. Reducing stress is always a positive for encouraging marbling deposition.

12. Wean early. Numerous research trials have shown that when calves are weaned early and fed a grain-based diet, marbling has been significantly higher.

University of Illinois research compared early weaned calves that were limit fed a corn diet from early weaning until traditional weaning age and programmed to achieve the same gain as creep fed, normal weaned calves. Then all calves were finished on the same diets. There were no differences in gain or days to slaughter between early weaned and creep fed steers. At harvest, early weaned calves had 34.5 more percentage points of carcasses with average Choice or higher levels of marbling (the marbling requirement for CAB). This is likely due to the extended days on a grain diet and the total number of days that a calf can deposit marbling. Feeding grain early in the animal's life can also proliferate fat cells—even more so than with creep feeding.

Fat can be deposited in cells that become larger. But, creating more marbling fat cells is significant because research has shown that the **number** of fat cells was more closely related to marbling score than was **cell size**.

13. Precondition calves before placement in a feedyard. Allowing calves to recover from weaning before they leave their home ranch will reduce overall total stress load in the animal's life. Combined with vaccination, it can lead to a higher level of effective immunity. This, in turn, tends to reduce sickness which is a major marbling reducer. Plus, preconditioned calves that are healthy and 'bunk broke' tend to start eating feed better after placement in the feedyard which fuels marbling.

14. Deworm cattle to reduce parasite load. Parasites consume calories and create stress for the animal resulting in fewer calories for fat deposition. Research has shown a strong affect on marbling and other carcass traits for cattle that were dewormed on pasture, at the feedlot, or both. One study comparing cattle dewormed both on pasture and in the feedlot showed 79 pounds more carcass weight and over 26 percentage points more Choice carcasses compared to the negative control that was not dewormed during the entire study.

15. Monitor vitamin levels. Vitamin A is high in lush forages. Supplemental vitamin A is routinely added to grain based finishing diets. However, since it is not very expensive, it is sometimes included at higher levels in the diet. A 2001 survey of 13 consulting nutritionists indicated typical finishing diets averaged 2070 IU/lb (range 1500 to 3300). By comparison, the 1996 *Nutrient Requirements of Cattle* (NRC) recommends 1000 IU/lb for feedlot cattle.

Research has shown high levels of vitamin A inhibit fat cell development. Some feeding trials at The Ohio State University have shown vitamin A restriction can increase marbling and percentage of Choice and Prime without affecting growth performance. However, other trials have shown either no effect or a small numerical advantage to vitamin A restriction. This variability in results could be caused by cattle entering a feedlot after grazing lush forage that have high levels of vitamin A stored in the liver.

Research has shown cattle that grazed wheat pasture took over 84 days for their blood level of vitamin A to decrease to a level that was equal to cattle that had been grown on grass-legume hay when they entered the feedlot.

16. Consider supplemental Zinc. Published research results are variable; however, some trials have shown an advantage in marbling and quality grade to feeding supplemental zinc. This advantage has generally been associated with an overall increase in fat deposition (both external backfat and marbling). Variability of results is likely associated with differences in body mineral stores at the initiation of the trial. Differences in the absorption of different forms of minerals might also add to the variance in results.

17. Use grower diets containing a moderate to high level of energy, preferably from corn, and avoid prolonged grazing periods during the stocker/backgrounding phase. A recent survey of 100 USPB producers with the highest grading average for all their cattle delivered, showed that 88% were grown in a dry lot. Of those, most were fed a corn/corn silage based grower diet.

This is significant for a couple of reasons. First, feeding higher energy grower diets can make more fat cells that will store fat within the meat as marbling. Rumen fermentation of starch from corn produces a volatile fatty acid (VFA) called proprionate. Proprionate is converted to glucose by the liver. When growing, developing muscle satellite cells are "bathed" in glucose, some of those cells will become fat cells that will store marbling.

Conversely, forage fermentation produces a higher percentage of the VFA called acetate. Acetate has been shown to be associated with external backfat deposition. In addition, lush forages are high in vitamin A, which as mentioned earlier, has been shown to inhibit fat cell development.

A second factor is that when calves are grown on limit-fed higher grain diets, they have smaller organ weights. This translates to lower maintenance requirements. Myers conducted a trial at the University of Illinois where all calves were early weaned, but half were immediately adjusted to an 87% concentrate diet and the other half grazed cool season pasture with two pounds of cracked corn daily. After 81 days, all calves were adjusted to the same finishing diet and were then harvested at less than 14 months of age. Liver and reticulum/rumen weights were about 13% less as a percentage of carcass weight for the steers that were weaned directly onto the high grain diet compared to those that grazed.

Another trial at Illinois by Wertz confirmed an advantage in efficiency of early weaned calves grown on high concentrate versus high fiber diets, where intakes were adjusted to achieve the same gain during the growing phase. All calves were then finished on the same diet. Heifer calves grown on the limit-fed high grain diet had a significantly better gain:feed ratio during finishing, compared to those grown on the high forage diet. This means that through lower maintenance requirements, calves that are grown on limit fed high grain diets, can have more excess energy available for marbling deposition during finishing.

Obviously, the practice of limit feeding goes hand-in-hand with feeding high grain grower diets, especially to young animals, those that are smaller framed and heifers. When total caloric intake far exceeds growth potential, fat will be deposited. In smaller framed, earlier maturing animals, especially heifers, this can result in light weight carcass discounts and a greater percentage of Yield Grade 4 and 5 carcasses.

Feed ingredients seem to make a difference. A University of Illinois creep feeding trial showed calves that were creep fed corn had a higher average quality grade than calves that consumed soyhulls as creep feed. After weaning, all calves were grown on a corn/corn silage diet and were then finished on a corn/chopped hay diet. All other carcass measurements were not statistically different.

Total calories still seem to be a major factor. In that same Illinois research, even the soyhull creep fed calves graded better than the controls which received no creep feed before weaning but were grown and finished on the same diets as the calves that were creep fed. Within the corn and the creep fed calves, half were limit fed and half were given unlimited creep. There was a linear increase in quality grade with the

unlimited creep calves grading highest, limited creep was intermediate and no creep had the lowest average quality grade.

18. Maintain body condition during backgrounding/growing periods. Another way to describe this practice would be to match total caloric intake to the animal's growth curve, or their growth potential at that point in their production. One of the first practices abandoned by USPB producers was "roughing" cattle through the winter with minimal inputs until spring grazing. This created a marbling "void" during that period of the animal's life. One of the elusive things about marbling is that it is not compensatory like other tissues. An animal does not compensate with a period of greater marbling deposition after a period of insufficient nutrition. In fact, when compensatory body weight gain does occur, it appears to be mostly in the area of external backfat.

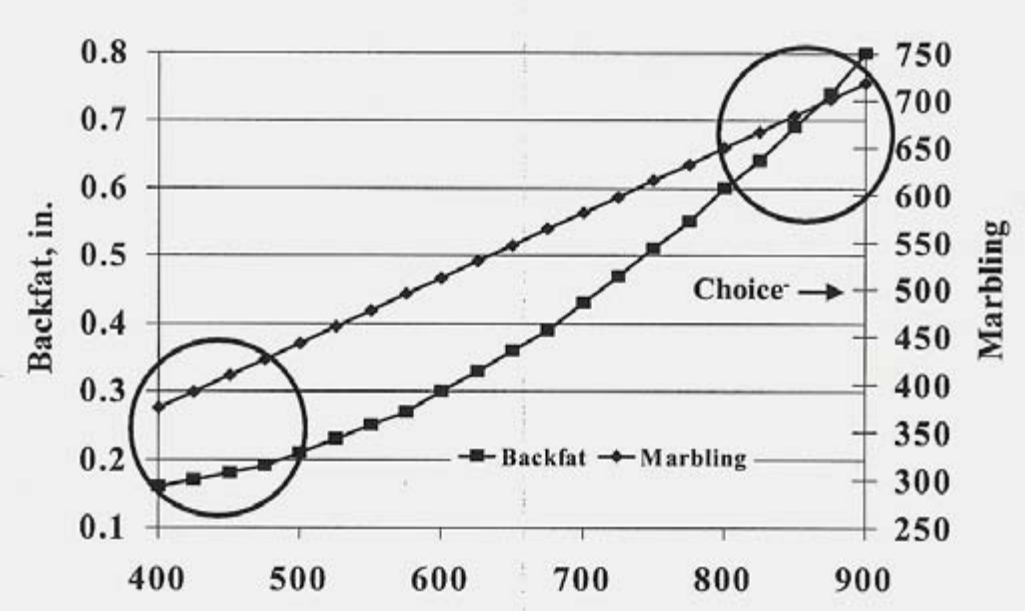
Different animals have different growth curves throughout their life. Steers and heifers, large and small framed animals, early and late maturity animals all grow very differently. Likewise, the type and level of growth promotants also have a large effect.

The main point here is to remember that marbling is excess calories, stored as fat. In addition, marbling is a lifetime achievement. We now understand through research that it can occur throughout the animal's life. Finally, there is no compensatory gain for marbling. Therefore, the way to increase marbling is to feed that animal throughout its life at a level of nutrition that not only maximizes growth of bone and muscle tissue, but also stores some excess calories as fat. However, as mentioned earlier, too many calories can result in excessive external backfat being deposited too early in the animal's life.

Research by Bruns from South Dakota State University used Angus steer calves that were approximately 8 months of age. They were backgrounded for 70 days and then fed a 90% concentrate corn-based diet. Treatment groups were harvested at target carcass weights of 450, 550, 650, 750 and 850 pounds. Harvest dates ranged from 48 days on the finisher diet, at about 10.4 months of age to a maximum of 252 days on the finisher diet, at about 15.5 months of age. Tissue growth rates were reported relative to carcass weight.

Marbling increased in a straight line while external rib fat and Yield Grade increased more rapidly relative to carcass weight at the end of the trial. **Figure 1** shows the rate of marbling score and rib fat increase relative to carcass weight. This proves that marbling is deposited evenly over a long period of growth and is not just deposited at the end of the feeding period. Therefore, management during backgrounding and early in the feeding period can have a dramatic effect on final marbling.

Figure 1. Marbling and backfat by carcass weight (Bruns research)



19. Sort calves during backgrounding or growing periods. Different animals have different growth curves and therefore, different maturity points. This is largely dependent on gender and frame size.

Large framed steer calves benefit from shorter backgrounding on grower diets and then being placed in the feedlot at an early age. This allows them to build up marbling earlier and reach a "market ready" body composition before their carcass weight begins to approach heavy weight discounts.

Heifer calves and smaller framed steer calves can be backgrounded longer and then placed in the feedlot later to allow them to harvest with a heavier carcass weight.

Sorting into outcome groups can also allow for strategic implanting. More conservative implants can be used on the large framed steers and stronger implants can be used on heifers. Sorting during backgrounding should also help to create more uniform feeding groups. Harvesting more cattle closer to their optimum body composition can increase marbling, especially if there are fewer cattle that are under fed and harvested as a Yield Grade 1 or 2.

20. Place cattle in the feedlot and begin feeding finisher diets before cattle get too heavy. Cattle that are placed on feed too heavy will not only have a lower yield or dressing percentage, but they also have a greater potential for heavy weight carcass discounts. If those cattle are harvested before they reach ideal body composition, they will have less marbling.

In addition, cattle that are grown or grazed on lower energy diets deposit less marbling. Then, if they are placed on feed too heavy, they will have less total days of excess calories to deposit as marbling. Since marbling is not compensatory, **final marbling is a direct result of the total number of days in the animal's life that it has had excess calories to be stored as fat**.

Also, cattle that are harvested at an older age can be more susceptible to having advanced skeletal maturity which is a factor in determining Quality Grade. Some carcasses have enough marbling to grade Choice, for example, but if they have advanced skeletal maturity, they can be downgraded to Select. Young maturity is also a specification requirement for branded beef programs like Certified Angus Beef® and Black Canyon® Premium Reserve. Carcasses with more extreme maturity can be classified as Hard Bone or Over 30 months.

21. Feed to an appropriate body fatness. Research has established that marbling deposition begins early in life. A few serial harvest trials of feedlot cattle have shown that marbling can plateau at the end of the feeding period; however, most research has shown that it continues through to harvest. Some have shown the rate of marbling deposition begins to slow closer to harvest. External fat increases rapidly with extended feeding as animals reach the point of maturity when muscle growth slows down. Therefore, matching feed calories to the animal's growth potential during backgrounding and then harvesting cattle at the appropriate body fatness is important to maximize marbling, but feeding cattle too long can result in discounts for over finished carcasses.

Table 1 shows USPB carcasses harvested in Kansas from fiscal year 2009 sorted by Yield Grade for steers and heifers. Yield Grade 1's are leaner and heavier muscled. Yield Grade 5's are fatter and have less muscling. As Yield Grade increases, marbling and Quality Grade increases. Economically, Yield Grade 3 carcasses had the highest average price per cwt of carcass weight. It's important to remember the USPB Base grid only discounts groups that exceed plant average for Yield Grade 4 or 5. Therefore, there are some Yield Grade 4 and 5 carcasses that were in groups that were below plant average and therefore, were not discounted.

Table 1. Fiscal 2009 USPB KS plant carcasses sorted by Yield Grade.

USDA Yield Grade	Avg. HCW (lbs.)	Back Fat (in.)	REA (sq. in.)	Actual less RREA	Avg. EBF (%)	Marbling Score Code	PR (%)	CH & PR (%)	CAB (%)	BCPR (%)	Light Weight (%)	Heavy Weight (%)	Avg. $/cwt.
Steers													
1	815	0.24	15.61	2.02	24.93	371	0.18	28.13	2.56	3.88	0.94	1.64	133.59
2	837	0.37	14.14	0.29	27.70	428	1.17	59.68	13.10	10.37	0.23	2.41	136.65
3	865	0.52	13.20	-0.99	30.60	480	3.89	80.81	27.19	15.40	0.07	4.43	139.32
4	903	0.72	12.40	-2.24	34.01	525	9.40	88.60	32.34	18.78	0.00	11.14	137.68
5	948	0.96	11.67	-3.52	37.98	572	18.98	92.84	7.67	0.51	0.00	27.36	130.55
Heifers													
1	754	0.26	15.27	2.41	24.89	383	0.33	35.40	3.04	4.92	2.07	0.40	134.85
2	769	0.40	13.85	0.81	27.72	443	1.73	66.94	14.66	10.17	1.03	0.56	137.68
3	794	0.56	12.94	-0.39	30.70	494	4.77	84.07	27.89	12.96	0.30	1.05	140.16
4	829	0.77	12.17	-1.58	34.15	533	9.40	90.19	29.19	18.01	0.08	2.62	137.90
5	867	1.02	11.51	-2.70	37.99	561	13.13	93.00	4.70	0.33	0.02	7.06	131.14

REA=ribeye area; RREA=required ribeye area; EBF=Empty Body Fat percentage; Marbling score 400=Small 0, 500=Modest 0.

22. Sort fed cattle at delivery. Sorting allows for a greater percentage of cattle to be harvested at the appropriate body fatness, as mentioned in the previous point. Many producers assume the value of sorting is to reduce outlier discounts like out weights or Yield Grade 4 and 5 carcasses. **The biggest benefit from sorting is finding cattle that can stay on feed longer and be fed from a Yield Grade 1 or 2 up to a Yield Grade 3**. This not only produces more total pounds of carcass weight, but can also increase marbling in those cattle that would be harvested "green" if the entire pen were marketed at one time.

Table 2 lists USPB lots that are sorted by percentage of Yield Grade 3 carcasses in the lot during fiscal year 2009. The greatest percentage of cattle had less than 40% Yield Grade 3 carcasses. All Quality

grades improved as percent Yield Grade 3 increased. Carcass weight increased up to greater than 50% Yield Grade 3 and Gross premium per head increased dramatically.

Table 2. Fiscal 2009 USPB KS Plant Carcasses Sorted By Percent Yield Grade 3 In The Lot

YG 3 %	% of All cattle	HCW (lbs.)	PR (%)	CH & PR (%)	CAB (%)	BCPR (%)	UG (%)	YG1 (%)	YG2 (%)	YG3 (%)	YG4 (%)	YG5 (%)	Gross Premium ($/head)
< 40%	37.6	802	2.18	62.12	13.26	9.22	3.13	15.08	45.78	30.67	7.36	1.11	23.48
40-49%	32.8	817	3.65	73.11	20.32	12.48	2.18	6.31	34.93	44.95	12.40	1.42	30.26
50-59%	21.0	826	5.11	81.72	26.96	14.43	1.48	3.18	27.46	54.24	13.76	1.36	40.34
60%+	8.6	820	5.85	86.09	33.85	15.37	0.90	1.52	20.21	66.40	11.21	0.66	53.73

23. Use implants wisely. Implants significantly increase carcass weight and improve feed conversion. They also have the potential to significantly decrease marbling. Essentially, this is done by their effect on muscle tissue to increase growth and that, in turn, can leave less excess calories available for marbling deposition. In addition, implants have been shown to negatively affect the development of marbling fat cells.

Implants essentially increase the growth curve of the animal. Feeding implanted cattle longer can allow the animal to reach a more appropriate total body fatness. However, if implants increase growth during backgrounding or shortly after feedlot placement, when total caloric intake is lower, it can create a marbling void that may not be recaptured, even with added days on feed. For some pens of cattle, the amount of added days on feed necessary to increase marbling may also result in heavy weight discounts and a high level of Yield Grade 4 and 5 carcasses since external fat thickness increases at a faster rate during extended feeding.

A recent review of implant research by J.D. Tatum of Colorado State University showed that, on average, single dose implant programs reduced marbling by 32 degrees. How much difference does 32 degrees of marbling make? Using the USPB database for cattle harvested during fiscal year 2009, a 30 degree drop in marbling across all carcasses would result in 12.6 percentage points lower Choice and Prime, 7.2 percentage points less Certified Angus Beef (CAB) and Prime would be cut nearly in half, decreasing 1.5 percentage points.

Therefore, the main thing to keep in mind is to match the strength, or potency of the implant, with the plane of nutrition. Some implants contain only estradiol, or estrogenic compounds. Others contain estradiol plus trenbolone acetate (TBA), the male androgen. Combination implants are more potent. Some implants have different release periods or "payout" period due the carrier they are embedded in.

In a survey of USPB producers who delivered the highest grading cattle during fiscal year 2006, 19% of the cattle did not receive any implants, another 19% were given nothing stronger than Ralgro®, the mildest product available, and just 53% were given a combination implant containing TBA. This is certainly well below industry averages for cattle fed at most commercial feedyards.

Data from the CAB Feedlot Licensing Program documented lots that received TBA implants compared to those that were implanted, but without TBA. Steers that received TBA implants had CAB acceptance rates that were 9.6 percentage points lower. In heifers, TBA implanted lots were only 3.0 percentage points lower. They also summarized lots that received a high (200 mg) dose of TBA compared to all other implant programs, including those that received a lower dose of TBA. Steers that received the high TBA had 6.7 percentage points lower CAB acceptance rates and 10.6 percentage points less Choice and Prime

carcasses. Heifers implanted with high TBA had 11.0 percentage points lower CAB and 9.7 percentage points less Choice and Prime.

To minimize their effect on marbling, implants should be used sparingly when cattle are grazing. The plane of nutrition is low and the potential for drought can decrease not only feed availability, but also feed quality. At feedlot placement, remember it will take several months to adapt cattle to the highest energy diet. Dry matter feed intake is also increasing during the first two months on feed. Therefore, using strong implants on the day of arrival can have a significant impact on marbling early in the finishing period. Also, if cattle are implanted at arrival and then reimplanted, be careful to avoid overlapping implants.

Dr. Tatum noted that **moderate implant programs** (one combination implant; a low-dose combination followed by a medium-does combination implant; or a low-dose followed by another low dose implant) were the best choice for balancing growth and carcass quality grade. His summary focused on research with steers; however, he noted that heifers typically show less improvement in performance and a smaller reduction in marbling score in response to implanting. He also mentioned that some delayed implant studies have shown an increase in marbling compared to implanting upon arrival at the feedyard. Delayed implanting refers to waiting until cattle have been placed on feed, anywhere from 30 to 84 days on feed. This allows cattle to reach a higher total daily caloric intake before being implanted.

One South Dakota State trial used 680 pound steers that were grown for 47 days and then finished for 93 days. Treatments included no implant, an estradiol/TBA (24 mg/120 mg) implant on day 1 or the same implant on day 56. Steers implanted on day 1 averaged Small 20 degrees of marbling which was significantly lower than delayed implant steers which averaged Small 36 and non-implanted steers that averaged Small 65. The delayed implant treatment and no implant treatment were not statistically different from each other. All three treatments were significantly different for the percentage of carcasses grading average Choice or greater, the marbling required for CAB. Non-implanted steers had 23.6%, delayed had 22.6% and those implanted on day 1 averaged only 7.8%.

Finally, some research trials have shown that implants can cause a small increase in skeletal maturity and can contribute to an increased incidence of dark cutters in some cattle. Marbling is the primary determinant of quality grade. However, skeletal maturity and lean color can also be a factor. Carcasses with advanced maturity or darker lean color will have a final quality grade that is adjusted down from their marbling score. This means that a carcass with just enough marbling to grade Choice could be adjusted down to a final quality grade of Select. Maturity and color are also included in the specifications for the CAB brand.

24. Feed <u>some</u> corn by-products in the finishing diet. Initially, the increased usage of distillers grain in feedlot diets was blamed for decreasing marbling. Lately, as more research continues, it appears that feeding a moderate level in the diet can increase marbling.

Distillers grain is the by-product of manufacturing ethanol. As a feed ingredient in feedlot diets it is very unique. It is low in starch and therefore, can improve rumen stability. When cattle eat a large meal of a high corn diet, the starch in corn lowers the pH and makes the rumen more acidic. If the pH stays too low for too long, acidosis can occur.

The distiller's grain also contains a higher level of fat than corn. Some researchers have suspected that as a cause for decreasing marbling when fed at a high level in some diets. It also contains a greater concentration of protein which can be beneficial, not only to the animal, but also to the rumen bacteria. Finally, distiller's grain appears to be very interactive with other ingredients in the diet. For example, low

levels (usually 20-25%) are more beneficial when used with steam flaked corn and higher levels (up to 30-35%) can be used with dry or wet corn.

In 2006, Chris Reinhardt, Kansas State, summarized a large number of trials and determined that levels above 30% of the total diet dry matter could reduce marbling. In 2009, Chris Calkins, University of Nebraska, compiled another multiple-trial study and determined that feeding 20-30% of the diet on a dry matter basis resulted in a 14-15 point increase in marbling score. There are many other considerations when adding distiller's grains to a finisher diet, like adjusting mineral levels, so be sure and consult with a qualified nutritionist.

25. Understand grain type and grain processing. It is hard to beat the starch in corn for encouraging marbling. A review by Owens and Gardner of 552 published research trials concluded that corn based diets produced 13 more degrees of marbling with the same or leaner average Yield Grade compared to either milo or wheat based diets. Corn diets also had significantly better feed conversion.

Table 3 lists the effect of grain processing method from the review by Owens and Gardner. Steam flaked diets significantly increased carcass weight and ribeye area, but not ribeye area in relation to carcass weight. Their average marbling score was significantly lower than other processing methods. However, steam flaked corn diets also had significantly higher dressing percentage and average daily gain. They also had significantly better feed conversion.

Table 3. Owens & Gardner research summary of grain processing method.

	WC	DRC	HMC	SFC
HCW	708 ^{b}	708 ^{b}	713 ^{b}	737 ^{a}
ADG	1.43 ^{b}	1.42 ^{b}	1.46 ^{b}	1.58 ^{a}
Feed/gain (DM)	6.37 ^{b}	6.37 ^{b}	6.45 ^{b}	5.43 ^{a}
Dressing %	61.90 ^{b}	62.40 ^{b}	62.40 ^{b}	62.90 ^{a}
REA, sq.in.	12.32 ^{bc}	12.31 ^{c}	12.63 ^{b}	13.07 ^{a}
Ext. fat, in.	0.42 ^{b}	0.44 ^{b}	0.48 ^{a}	0.52 ^{a}
YG	2.75 ^{ab}	2.69 ^{b}	2.84 ^{a}	2.85 ^{a}
Mb score	512 ^{ab}	524 ^{a}	519 ^{a}	482 ^{b}

WC=Whole corn; DRC=Dry rolled corn; HMC=High moisture corn; SFC=Steam flaked corn
a,b,c Values with different superscript letters are statistically different.

26. High oil corn has been shown to increase marbling. A University of Idaho study compared regular corn to high oil corn. All grain was processed as dry rolled corn. No differences were observed in live or carcass performance; however, cattle fed high oil corn for 84 days had 47 more degrees of marbling. Another study at Iowa State compared high oil corn to regular corn plus added fat. All grain was fed as whole corn. Again, there were no differences in carcass characteristics except those that were fed the high oil corn had 14 percentage points more carcasses that graded Choice.

However, before you go and plant all high oil corn, remember to compare yield results and consider the cost of producing high oil corn that may have greater seed cost, a lower yield per acre and a greater cost of production per bushel harvested.

27. Reduce stress for the animal. It's been said that to maximize marbling, make sure the animal "never has a bad day". Stress can include extreme weather, improper animal handling, disease/sickness and transportation.

Reducing stress throughout the animal's life will allow more "good" days to deposit marbling. Reducing stress during shipment prior to harvest can help maintain marbling. It is commonly believed that marbling can be mobilized or "burned" for energy when the animal needs it. After all, fat deposition is the body's way of storing excess calories for later use. Unfortunately, there's still a lot we don't know about the mobilization of marbling during times of stress.

One study compared a 24 hour feed withdrawal compared to feed access up until loading and a 189 mile haul to the packing plant. Marbling was not reduced, but carcass weights were nine pounds lighter and the percentage of dark cutters tended to increase for cattle that were limited feed access prior to shipment. It was concluded that marbling was not mobilized in this trial because feed tends to remain in the rumen and nutrients are still being digested and absorbed, even after a 24 hour fast. However, dark cutters are caused by a depletion of glycogen, or blood sugar. So although marbling was not mobilized, the stress of fasting did appear to initiate the depletion of glycogen.

Severe winter storms in January, 2007 caused a profound decrease in grading. Typically, moderate winter weather can add days on feed to cattle and actually improve marbling. Analysis of USPB carcass quality related to temperature has shown an inverse relationship, as temperatures go down, Quality grade generally increases.

Transportation is stressful enough. Low stress animal handling can reduce some of the stress. Less stress during delivery, pre-harvest can help reduce the incidence of dark cutters. Not only do "official dark cutters" not grade Choice or Prime, but carcasses from pen mates can be "partially dark". This means the lean color was not dark enough to become an "official dark cutter", but the color was dark enough to decrease overall quality grade, from Choice to Select, for example. However, a significant number of dark cutters is usually caused by several factors occurring at the same time.

Individual USPB carcasses with Small 0-20 marbling (the lowest marbling required for Choice) that were harvested during September were analyzed. This is the normal peak period for dark cutters. There were 2.5% of those carcasses that were official dark cutters and a similar amount, 2.3%, were downgraded to Select with the same level of marbling. Reasons for this downgrade would be partially dark lean color and/or advanced skeletal maturity.

Fairleigh Feedyard of Scott City, KS, installed a "Bud Box" designed by animal handling expert, Bud Williams, in their loadout after recommendation from their consulting veterinarian, Dr. Tom Noffsinger. Since its installation, that feedyard has noticed a small, but significant reduction of dark cutters in their USPB cattle. Manager, Jerry Kuckelman, commented that the combination of the Bud Box and having their own employee load cattle onto trucks, using low stress animal handling principles, has had a huge financial impact on their operation.

Stress can also come in the form of an upset stomach. High concentrate diets have the potential to cause acidosis. Good bunk management helps maintain a steady dry matter feed intake. This not only improves the rumen efficiency, it also reduces stress to the animal. Feeding an ionophore like Rumensin® also helps to maintain consistent intake and gut stability through its effect on the rumen bacteria population. Likewise, as mentioned earlier, the lower starch content of corn by-products can also help reduce acidosis.

Choice/Select spreads have been low recently due to the world economy's effect on consumer spending coupled with a greater supply of Choice and a smaller supply of Select grading beef. Some producers may be questioning the future of high quality beef production. Keep in mind that Quality grade has contributed the most to overall premium ***every*** fiscal year of USPB's history—even during years when spreads are lower.♦
