Virginia Cooperative Extension
A partnership of Virginia Tech and Virginia State University

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Livestock Update

Beef - Horse - Poultry - Sheep - Swine

February 2010

This LIVESTOCK UPDATE contains timely subject matter on beef cattle, horses, poultry, sheep, swine, and related junior work. Use this material as you see fit for local newspapers, radio programs, newsletters, and for the formulation of recommendations.

IN THIS ISSUE:

Scott P. Greiner, Extension Project Leader
Department of Animal & Poultry Sciences

Dates to Remember

BEEF

FEBRUARY

11-12 VA Beef Industry Convention. Roanoke. ***Contact:*** Bill McKinnon, (540) 992-1009 email: bmckinnon@vacattlemen.org

18 Beef Webinar. ***Contact:*** Mark McCann, (540) 231-9153, email: mmccnn@vt.edu

MARCH

18 Beef Webinar. ***Contact:*** Mark McCann, (540) 231-9153, email: mmccnn@vt.edu

21 VA BCIA Southwest Bull Test Open House. Dublin. ***Contact:*** Scott Greiner, (540) 231-9159, email: sgreiner@vt.edu

27 VA BCIA Southwest Bull Test Sale. Wytheville. ***Contact:*** Scott Greiner, (540) 231-9159, email: sgreiner@vt.edu

APRIL

16-18 VA Beef Expo. Harrisonburg. ***Contact:*** Bill McKinnon, (540) 992-1009, email: bmckinnon@vacattlemen.org

MAY

21-22 Angus Boot Camp, Alphin Stuart Arena. Contact: McCann, (540) 231-9153, email: mmccnn@vt.edu

HORSE

FEBRUARY

19-20 B&B Hippology Contest and Horse Judging Contest. Alphin-Stuart Arena. Blacksburg. ***Contact:*** Julia McCann, (540) 231-7384, email: jsmccann@vt.edu

MARCH

3 VA Forage & Grassland Council/VCE Winter Equine Conference. The Meadows Event Park. Doswell. ***Contact***: Shea Porr, (540) 687-3521, ext. 27, email: cporr@vt.edu

4 VA Forage & Grassland Council/VCE Winter Equine Conference. Virginia Horse Center. Lexington. ***Contact***: Shea Porr, (540) 687-3521, ext. 27, email: cporr@vt.edu

5 VA Forage & Grassland Council/VCE Winter Equine Conference. MARE Center. Middleburg. ***Contact***: Shea Porr, (540) 687-3521, ext. 27, email: cporr@vt.edu

APRIL

9-11 State 4H/FFA Horse Judging and 4H Hippology, Horse Bowl and Presentations. Location to be determined. ***Contact:*** Celeste Crisman, (540) 231-9162, email: ccrisman@vt.edu

MAY

12-14 Technical Large Animal Emergency Rescue Training. MARE Center. Middleburg. ***Contact***: Shea Porr, (540) 687-3521, ext. 27, email: cporr@vt.edu

17-19 Technical Large Animal Emergency Rescue Training. MARE Center. Middleburg. ***Contact***: Shea Porr, (540) 687-3521, ext. 27, email: cporr@vt.edu

February Beef Management Calendar

Dr. Scott P. Greiner
Extension Animal Scientist, VA Tech

Spring Calving Herds

- Have all calving supplies on hand and review calving assistance procedures
- Move pregnant heifers and early calving cows to calving area about 2 weeks before due date
- Check cows 3 to 4 times per day during calving season, heifers more often to assist early if needed
- Keep calving area clean and well drained, move healthy pairs out to large pastures 3 days after calving
- Ear tag and dehorn all calves at birth; castrate male calves in commercial herds
- Give selenium and vitamin A & D injections to newborn calves
- Late gestation mature cows should gain 1.0 lbs per day
- Target gain for pregnant heifers and 3-yr olds should be 2.0-2.5 lbs per day
- Keep high quality, high magnesium mineral available
- Vaccinate cows against scours if it has been a problem
- Evaluate herd genetic goals and assess bull battery, make plans to attend spring bull sales and/or order AI semen
- Frost seed clovers (mid to late in the month)

Fall Calving Herds

- End breeding season early in the month
- Remove bulls and check condition
- Begin creep feeding or creep grazing calves if desired
- Plan marketing strategy for calves
- Begin feeding high magnesium minerals to prevent grass tetany
- Continue to check calves closely for health issues
- Frost seed clovers (mid to late in the month)

Cassady Featured Speaker at Beef Convention for Virginia BCIA Educational Program February 12

Dr. Scott P. Greiner
Extension Animal Scientist, VA Tech

Dr. Joe Cassady from North Carolina State University will be the featured speaker for the Virginia BCIA Educational Program and Annual Meeting to be held in conjunction with the Virginia Beef Industry Convention at The Hotel Roanoke on February 12 at 4:00 p.m. As faculty member in the Department of Animal Science at NCSU, Cassady teaches courses in genetics and conducts beef cattle feed efficiency research. Dr. Cassady is also Executive Director of the Beef Improvement Federation.

Dr. Cassady will be discussing "Application of DNA Markers to Genetic Improvement in Beef Cattle: Past, Present, and Future." Following Dr. Cassady's presentation, Virginia BCIA will conduct a short annual meeting and present its awards. The session will be open to all attendees at the Convention and immediately follows the afternoon general session.

Beef Webinar Focuses on Calving Management and Neonatal Calf Care - February 18th

Dr. Mark A. McCann
Extension Animal Scientist, VA Tech

Dr. Jeff Ondrak from the Great Plains Veterinary Education Center at the University of Nebraska will be the featured speaker for the third Beef Webinar sponsored by Virginia Cooperative Extension and scheduled for 6:30 p.m., Thursday, February 18th. Dr. Ondrak is a Beef Cattle Clinical Veterinarian whose duties include teaching veterinary students, supporting ongoing research projects and veterinary care at the Meat Animal Research Center in Clay Center.

Dr. Ondrak will be providing a discussion of calving managemnt and neonatal calf care. Participants in the on-line meeting will have the opportunity to ask questions through an on-line chat box or over the telephone using a number provided during the program. Check with your Extension Agent about accessing the program at your local office. Producers with high speed internet service can access the meeting at home. The web address to join the meeting is http://connect.extension.iastate.edu/beefcattlewebinar/ . Alternatively, webinar information and meeting links are also available on the VT Beef Extension webpage http://www.vtbeef.apsc.vt.edu/ . From the VT Beef Extension site, you can click on the meeting link and go directly to the meeting.

A recording of the December webinar on *Winter Cow Nutrition* and the January webinar on *Beef Industry Outlook* can be accessed through the VT Beef Extension page. In addition to the February 18th meeting, the final winter webinar is scheduled for March 18th. If you have questions please contact Mark McCann at (540) 231-9153 or mark.mccann@vt.edu.

Include Clover in 2010 Forage Plans

Dr. Mark A. McCann
Extension Animal Scientist, VA Tech

An important tool that is available to supply nitrogen to cool season pastures is the addition of clovers. During earlier periods of inexpensive nitrogen fertilizer, clovers were considered a valuable addition to dilute infected tall fescue, improve forage quality and also supply nitrogen. More recently, the cost of commercial nitrogen has rearranged the priority list with clover's ability to fix nitrogen perhaps being the most economically important.

Nitrogen is "fixed" in clovers through a symbiotic relationship with rhizobium bacteria that infect roots. The plant provides energy for the bacteria and bacteria provide the "machinery" necessary to convert atmospheric nitrogen to a form available to plants. Most people picture a 'conduit' that transports nitrogen directly from clover to grass. Unfortunately, almost no nitrogen is contributed in this mode. Essentially, nitrogen is supplied to grasses indirectly via the decomposition of the clover root nodules. Nitrogen must then be converted into a form available to plants. This conversion or 'mineralization' releases nitrogen slowly- more like a time release fertilizer than an application of ammonium nitrate or urea.

After perennial clovers are well established, nitrogen will be released to grasses at a relatively constant rate as nodules decompose. White clover can fix 50-125 pounds of nitrogen per year and red clover can fix 75-150 pounds depending on stand, soil and growing conditions. At current urea prices this translates to $25-$75 per acre in added nitrogen.

When clover makes up less than 15% of the stand, it may also be beneficial to fertilize with nitrogen. Under these conditions, clover is contributing little nitrogen to the system and overall forage production could be increased with nitrogen addition. Clover leaves and stems contain approximately 5-6% nitrogen by weight. This nitrogen can be made available to grasses through animal urine and manure. Grazing activity recycles a large amount of nitrogen to the pasture. However, when grazing distribution is uneven, nitrogen may be concentrated around water sources or shade where animals congregate.

Successfully adding clovers can be accomplished by broadcast seeding during the winter months (frost seeding). A study conducted at the Kentland research farm by Dr. Ben Tracy in 2009 compared frost seeding and no-till planting of clover. The pastures consisted of mostly tall fescue, bluegrass and some orchardgrass. Clover had not been sown into experimental pastures in recent years. Before establishment of seeding treatments, each pasture was heavily grazed by cattle to remove standing dead vegetation. Pastures were then fertilized with phosphorus (P) and potassium (K) as recommended by soil test. Soil pH was above 6.5 on all pastures so no lime was added. On February 4, 2009, one half each pasture was sown with a mixture of red (Juliet), ladino white (Pinnacle) and white clover (Kopu II) using a broadcast seeder. On March 10th, the remaining half of each pasture was planted with the same legume mixture using a no-till drill. The seeding rate was 4, 2 and 2 lbs/ac. for red, ladino and white clover, respectively. Table 1 contains the percent ground cover of clover from April – August.

Table 1. Percent ground cover occupied by clovers during 2009 growing season. No significant statistical differences were found between seeding methods in any month.

	April		June		August	
	Frost-seed	Drill	Frost-seed	Drill	Frost-seed	Drill
	----------Percent----------					
Red clover	1	1	8	12	14	13
White clovers*	3	3	28	17	26	20
Total	4	4	36	29	40	33

*White clovers included both sown Ladino and white clovers as they could not be visually separated

The clover component in pastures increased more than 20 fold from April to August 2009. Broadcast frost-seeding and no-till drilling were equally effective for establishing clover. The scientist credited the successful clover establishment to a combination of factors: 1) heavy, mob grazing in winter that reduced standing dead vegetation and helped seedling emergence, 2) timely frost-seeding during 1st week February, 3) aggressive rotational grazing in spring that simultaneously reduced grass competition and allowed clovers to grow enough to establish, 4) good soil fertility (adequate P, K and pH) to stimulate clover growth, and 5) rainfall, which was abundant during the 2009 growing season. The exact factors that determine successful clover establishment still remain elusive; as there are probably combinations of events involved. The good news is that producers can control most of these variables through management (e.g., seeding time, stocking rate) and, by doing so, should increase their chances of successful clover establishment in permanent pasture. For more details refer to VCE publication ***No-Till Seeding of Forage Grasses and Legumes*** **(**http://pubs.ext.vt.edu/418/418-007/418-007.html). The addition of clover is an economical method to increase the productivity and quality of fescue pastures.

Crossbreeding - Its Cool Again!: Part 3

Dr. Scott P. Greiner
Extension Animal Scientist, VA Tech

Note: This article is Part 3 in a three part series dealing with crossbreeding.

The fundamentals concerning the basic advantages of crossbreeding were outlined in Part 1 of this series. The primary advantages of crossbreeding include capturing heterosis (hybrid vigor) and breed complimentarity. Part 2 focused on the design and management of crossbreeding systems, with specific attention on the application for small herds. Additionally, tools such as the incorporation of artificial insemination, use of hybrid bulls, and purchasing replacement heifers were discussed as mechanisms to enhance the management ease of crossbreeding systems.

Crossbreeding systems have been abandoned by some producers who have cited problems maintaining uniformity in the cowherd as well as the calf crop with certain crossbreeding systems. Certainly, the potential for mongrelization of the herd exists if a crossbreeding program is not well designed and managed. This article will focus on the key aspects relative to individual sire selection that are important for maintaining a breeding system that will work over several generations.

As with any breeding system, sire selection is critical for genetic improvement. With crossbreeding systems, more than one breed of sire is typically used. As a result, the calf crop and female replacements are potentially sired by different breeds and individual bulls within those breeds. It is the differences between the breeds utilized, as well as differences in individual sires used, which contribute to variation in a set of cows or a calf crop. Therefore, for a crossbreeding system to be viable, sire selection (both within and between breeds) is critical for maintaining uniformity from one generation to the next- while at the same time taking advantages of the strengths of the various breeds used in the system.

The most fundamental sire selection decision is the choice of breed. Choice of breeds to be used in the cross will be dependent on several factors, including the environment and resources of the operation, marketing program for the calf crop, and targeted carcass merit endpoint. Considerable differences between breeds exist that may effectively be utilized by crossbreeding. As mentioned previously, optimum performance rather then maximum performance is desired for virtually all economically important traits. For this reason, ½ to ¾ British x ¼ to ½ Continental females tend to optimize mature size, milk production, and adaptability for many Virginia producers.

The breeds chosen, and the percentage of each breed represented in the calf crop also have a pronounced impact on carcass characteristics. Coupling the general superiority of the British breeds for marbling potential with the red meat yield advantages of the Continental breeds results in offspring that have desirable levels of both quality grade (marbling) and retail yield (yield grade). The specific end product target will dictate the combination/percentage of breeds that are most likely to generate cattle with the desired carcass traits. Utilizing breed differences for carcass traits to match marketing grids will be important for producers as more retained ownership and value-based marketing is practiced.

Selection of bull within breed is equally important. EPDs are a very useful and important tool in accomplishing this task. At the same time, breed strengths and weaknesses and the genetic merit of a breed as a whole for a particular trait also need to be considered when bulls are selected for use in a crossbreeding system. In other words, EPDs need to be considered on both a within and across-breed basis for effective bull selection in a crossbreeding program. Using the EPDs in this manner will assist the producer in minimizing large fluctuations in performance and production from one generation to the next when using more than one breed.

The following table can be used to compare the EPDs of bulls from different breeds. To put the EPDs on a comparable basis, simply add or subtract the adjustment factor to the within-breed EPD of the bull. For example, consider a Simmental bull with a YW EPD of +55 and a Charolais bull with YW EPD of +25. To fairly compare the YW EPDs of these two bulls of different breeds, the EPDs must first be adjusted to a common equivalent using the across-breed table. Using the table, the Simmental bull would have an across-breed YW EPD of +77.4 (55 + 22.4) and the Charolais bull an across-breed YW EPD of +76.9 (25 + 51.9). In this example, we would expect the growth rate of the progeny of the Simmental bull and Charolais bull to be very similar on average, since their across-breed YW EPDs are very similar. Both would be roughly equivalent to an Angus bull with a +77 YW EPD (no adjustment needed for Angus). Across-breed EPDs may be calculated for the growth and maternal traits of any breed listed in the table. They may be used to compare bulls of different breeds that are being used in the crossbreeding program for similar purposes (i.e. milk production in Gelbvieh and Simmental, or growth in Simmental and Charolais).

2009 Adjustment Factors to Add to EPDs of Various Breeds to Estimate Across-Breed EPDs				
Breed	Birth wt.	Weaning wt.	Yearling wt.	Milk
Angus	0.0	0.0	0.0	0.0
Braunvieh	7.5	21.4	12.8	30.6
Charolais	9.7	38.2	51.9	5.6
Gelbvieh	4.5	1.7	-12.6	9.9
Hereford	2.9	-2.8	-16.1	-17.5
Limousin	4.2	-3.4	-28.6	-14.2
Maine Anjou	5.5	-10.7	-22.8	-0.8
Red Angus	2.9	-5.4	-4.4	-3.0
Salers	3.4	22.7	52.3	13.1
Shorthorn	6.1	19.9	52.8	23.1
Simmental	5.5	25.0	22.4	13.7
Tarentaise	2.5	29.7	17.9	22.2

The adjustment factors may also be useful in managing uniformity when breeds are rotated in a crossbreeding system to avoid large fluctuations in traits such as birth weight and milk. For example, using these adjustments, it can be demonstrated that a Gelbvieh bull with a milk EPD of +15 will add similar milk genetics to an Angus bull with a milk EPD of +25 (both the bulls would be approximately +25 on an across-breed basis). This example demonstrates the differences between the breeds that exist- a Gelbvieh bull with a +15 milk EPD ranks in the lower 30% of the Gelbvieh breed for milk genetics, whereas the Angus bull with a milk EPD of +25 ranks in the top 25% of the breed.. With this in mind, a Gelbvieh bull can be selected to

compliment an Angus cow base that will add a moderate amount of milk. Similar calculations can be made for birth weight and growth. The key is to recognize the basic genetic differences between breeds, and then select of bulls within those breeds with optimum genetics while avoiding extremes.

Another key factor for crossbreeding sire selection is the matching of frame score across the individual bulls selected. Frame score has a strong relationship with cow size. Therefore, minimizing differences in the frame scores of the bulls used to produce replacement females will assist in minimizing differences in mature size of the resulting cowherd. This coupled with avoiding large differences in milk production is the key to having a cowherd that is uniformly adapted to the resources of the operation even though several breeds are represented. Minimizing differences in frame score will also assist in minimizing differences in the calf crop.

For many feeder cattle producers, coat color is an economically important trait. Today's genetics offer the opportunity to stabilize coat color and still maintain a crossbreeding program. Technological advances such as DNA genotyping have made it possible to more easily manage coat color in several breeds. Therefore, coat color does not need to be a limiting factor to maintain a crossbreeding program.

In summary a well-designed, manageable crossbreeding system is an important aspect in making genetic progress in the various economically important traits that drive profitability in today's beef industry. To accomplish this task, bull selection must consider both within and across-breed differences to optimize genetics which influence reproductive efficiency, maternal performance, growth and feed efficiency, and end product merit.

A Systematic Approach to Bull Buying

Dr. Scott P. Greiner
Extension Animal Scientist, VA Tech

With the onset of bull buying season, having a systematic approach to finding and identifying the "right" bull is imperative. Bull selection is the most critical factor for genetic improvement in cow-calf herds, as the influence of the bull impacts both the immediate calf crop as well as future calf crops through the performance (and costs) of his daughters. Consequently, bull selection warrants careful planning and preparation, well in advance of any sale or visit from an AI representative. Consider the following steps to assist in the bull-buying process:

1) **Identify Herd Goals**- Herd goals serve as the foundation for sire selection and provide guidance as to traits with the most relevance. Defining the production and marketing system, along with management strategies and environment are key factors that warrant consideration:
    Will the bull be used on heifers, mature cows, or both?
    Will replacement females be retained in the herd?
    How will the calf crop be marketed (at weaning?, backgrounded?, retained ownership? sell females?)
    What are the labor and management resources available?
    What are the feed resources and environmental conditions of the operation?

2) **Assess Herd Strengths and Weaknesses**- Fundamental records are necessary to identify herd strengths and weaknesses. Basic performance parameters such as calving percentage, weaning percentage, weaning weights, sale weights, carcass merit, feed usage, etc. are necessary to serve as the basis for assessing areas of strength and those needing attention.

3) **Establish Selection Priorities**- Concentrate on those factors which stand to have the largest impact on profitability. Remember that income is derived from performance (sale weight, % calf crop weaned, carcass merit, etc.). Performance is a function of both genetics and environment/management. Superior genetics can be negated by poor management, which emphasizes the importance of separating the impact of management (nutrition, health program) from that of genetics when specific priorities for the herd are established. Considering both the genetic and management influences on various traits is important. Focus on the handful of priority traits rather than attempting to change many traits simultaneously. Establishing the few traits to focus on is the key factor.

4) **Utilize Selection Tools**- Once selection priorities have been established through close examination of herd goals and current status, a number of useful tools are at the disposal of beef producers to assist in making genetic improvement. Genetic differences across breeds have been well established, and utilization of different breeds in a complimentary fashion through structured crossbreeding plans provides the opportunity for improvement in multiple traits. Most importantly, heterosis attained through crossbreeding has been shown to have significant favorable impacts on traits such as reproductive efficiency and cow longevity which are critical for herd profitability. The limited ability to select for

reproductive traits in the form of EPDs further emphasizes the importance of capturing the value of heterosis.

EPDs are available for many traits of economic importance. The introduction of economic indexes which combine several related traits and their economic values into one EPD are available to assist with simultaneous improvement in multiple traits which impact areas such as carcass merit and post-weaning profit. Again, with the large number of EPD tools available, the critical step is to determine the EPDs which are most important and establish benchmarks relative to each.

5) **Establish Benchmarks**- Several tools can be utilized to assist in the determination of EPD specifications. EPD values for current and past sires can be used as benchmarks. With these benchmarks, EPD specifications can be set to reflect the desired increase or moderation in performance for a particular trait. As an example, establishing a benchmark for milk EPD can be determined through the relationship between previous sires' genetics for milk and the performance of his daughters in the herd.

6) **Find Source**- With the above defined, we can now begin to look at individual bulls. There are many sources of bulls that warrant consideration- production sales, test stations, and private treaty sales. Of critical importance is that the bull be from a reputable source which will stand behind their product. It may be necessary to look at several sources in order to find the correct bull.

7) **Do Your Homework**- The first step to doing so is to evaluate the sale catalog, performance pedigree, and data. By examination of the bull's performance record, determine which bulls meet the EPD and other specifications that have been established (and likewise eliminate those that do not meet the specifications). Be prepared to make trade-offs, as the perfect record may not be attainable. Do not be surprised or alarmed when the bulls you have highlighted appear scattered throughout the sale order. Remember to stick to the selection criteria and qualifications/specifications that have been established. All this can and should be accomplished prior to departing for any sale.

8) **Take a Look**- Once the list has been narrowed to only bulls which meet the criteria, these bulls can be further evaluated and selection refined. Having a list of suitable bulls prior to arrival at the auction or farm will not only save time, but also assist in making sure the right bull for the situation is purchased. Upon narrowing the potential candidates on paper, the bulls can be evaluated for suitability of phenotypic traits and the potential candidate list shortened even further. Not all relevant traits have EPDs (examples include disposition, foot soundness, fleshing ability, etc.), and therefore must be evaluated visually.

9) **Make a Sound Investment**- For many cow calf producers, purchasing a new bull is a relatively infrequent occurrence. This emphasizes the importance of selecting the right bull, particularly in single sire herds. The value of the right bull cannot be underestimated. Investments in good genetics will pay dividends both short and long-term through the influence the bull has on each calf crop as well as his daughters that are retained in the herd.

10) **Manage the New Bull Properly**- Of equal importance is the care and management of the newly acquired bull. Proper management and nutrition are essential for the bull to perform satisfactorily during the breeding season. With most new herd sires purchased as yearling bulls- management prior to, during, and after the first breeding season is particularly important. Plan ahead by acquiring a new yearling bull at least 60 to 90 prior to the breeding season so that ample time is available to allow for adjustment to a new environment, commingling with other bulls, and getting the bull in proper breeding body condition.

2010 Southwest Bull Test: Sale, Open House, & Bred Heifer Sale

Dr. Scott P. Greiner
Extension Animal Scientist, VA Tech

An open house will be hosted at the Virginia Beef Cattle Improvement Association's Southwest Virginia Bull Test on Sunday afternoon, March 21st from 1:00 to 4:00 PM. Cattle producers and others interested are invited to attend. The Southwest Bull Test Station is located at Hillwinds Farm, owned and operated by Tim Sutphin of Dublin, Virginia. The station is located just outside Dublin. From Dublin, travel south on Route 11 just over two miles, and turn right on Thornspring Road/Rt. 643 (Cougar Express convenience store on corner). Proceed on Thornspring Road a little over a mile and the facility is on the left.

A total of 207 bulls are currently on test at Hillwinds Farm, including 102 fall-born senior bulls and 105 spring-born junior bulls. Breeds include Angus, Charolais, Gelbvieh, Gelbvieh Balancer, Polled Hereford, Simmental, and SimmAngus. The top two-thirds of these bulls will be sold on Saturday, March 27th at 12:00 noon. The sale will be held at the Umberger sale facility, just outside Wytheville. Only bulls which meet stringent BCIA criteria will sell. BCIA has made some significant changes to the program which has been brought about through feedback from commercial bull buyers. Highlights include complete breeding soundness exams (including semen evaluation) on fall-born bulls, volume buyer discounts, and an enhanced soundness and fertility guarantee on all bulls selling.

The BCIA-Influenced Bred Heifer Sale will be held in conjunction with the bull sale. A select group of 50 fall-calving bred heifers from leading producers will be offered immediately following the bulls. All heifers will be certified through the Virginia Premium Assured Heifer Program, which verifies health, genetics, and management procedures. Service sires for the heifers will feature highly proven, AI sires selected for calving ease and performance.

Complete information can be found on the VA BCIA website http://www.bcia.apsc.vt.edu, or phone 540/231-9163.

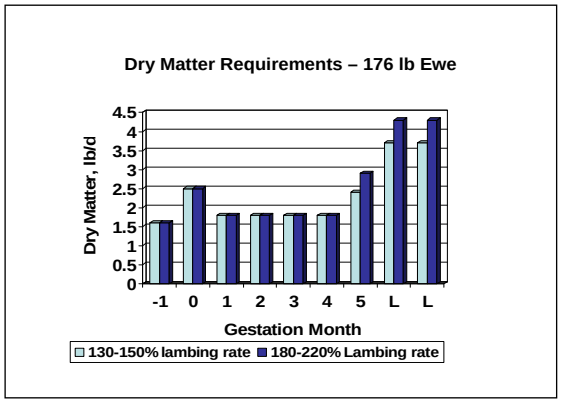
Ewe Nutrition and Management; Do's and Don'ts

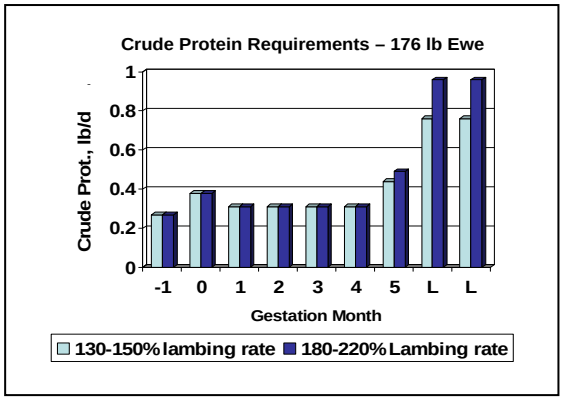
Dr. Mark A. McCann
Extension Animal Scientist, VA Tech

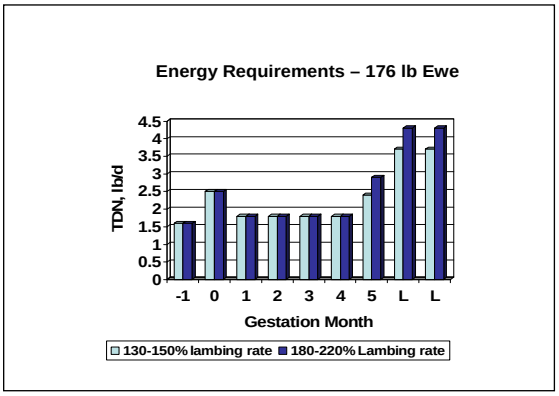
Ewe nutrition and management play critical roles in both the performance and profitability of a sheep enterprise. Incorrect assumptions or errors can negatively impact ewe and lamb performance while overcompensation with supplements can reduce the chance of profitability. The following is offered as recommendations to prevent either occurrence.

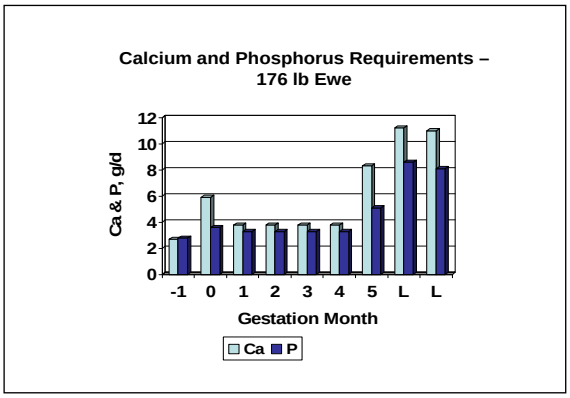
The fundamental issue of ewe nutrition is well documented and it is important to begin with the basics. The following figures document ewe requirements for dry matter, crude protein, TDN and calcium and phosphorus by month of gestation and lactation. It is essential to be aware of the ewe's nutrient requirements as you map out a strategy to meet them. Research and experience have demonstrated that underfeeding is false economy and can lead to reduced lambing rate, low birth weight, poor lamb vigor and reduced milk production. On the other hand, being too quick to supplement can result in fat ewes and thin wallets.

- Do make a proactive strategy of meeting ewe nutrient needs
  - Matching forage resources to ewe needs
  - Group as possible by nutrient need (age, TOB)









Grazed or stored forages are the foundation of any ewe nutrition program. Table 1 provides supplementation recommendations related to the TDN and crude protein content of hay. Spring lambing flocks can take advantage of new pasture growth which is very digestible and high in protein. Generally, this will meet the nutrient needs of ewes nursing singles. Ewes nursing twins will respond to low levels (1-1.5lb/d) of energy supplementation.

- Do forage test stored hay
- Do maximize grazed forages while minimizing hay needs
- Do consider lambing season in view of quality pasture

Table 1. Forage Quality and Supplementation (176 lb ewe)[1]

Forage Analysis									
CP % of DM	TDN % of DM	Early[2] Gestation		Late[3] Gestation		Early[4] Lactation		Late[5] Lactation	
		Lbs SBM	Lbs Corn	Lbs SBM	Lbs Corn	Lbs SBM	Lbs Corn	Lbs SBM	Lbs Corn
11.2 & over	56 & over	-	-	-	.75	.5	2.5	.3	1.5
9.5 - 11.1	56 & over	-	-	.15	.75	.8	2.5	.45	1.5
	53 - 56	-	-	.15	.85	.8	2.7	.45	1.65
	50 - 53	-	-	.15	1.0	.8	2.9	.45	1.80
8.2 - 9.5	54 - 56	-	-	.25	.8	1.0	2.5	.55	1.5
	51 - 54	-	.2	.25	1.0	1.0	2.75	.55	1.75
	50 & under	-	.4	.25	1.2	1.0	3.0	.55	2.0
7.3 - 8.2	53 – 55	.1	-	.4	.8	1.1	2.5	.6	1.5
	51 – 53	.1	.2	.4	1.0	1.1	2.75	.6	1.75
	50 & under	.1	.4	.4	1.2	1.1	3.0	.6	2.0
Under 7.3	Under 48	.2 - .3	.5 – 1.0	.4 - .5	1 -1.5	1.2 -1.5	2.5 -3.5	.7 - .8	2.0 -3.0

[1] Recommendations are made on basis of 44 % soybean meal and ground shelled corn. Other supplements can be used to deliver the same amount of energy and protein.
[2] Dry ewes in the first 15 weeks
[3] Last 4 weeks of pregnancy (200% lambing rate expected).
[4] First 6-8 weeks of lactation suckling twins
[5] Last 4-6 weeks suckling twins.
** Note 1.5lbs of corn gluten feed can replace 1.0 lb corn and .5 lb soybean meal.

- Do monitor body condition of the ewe to determine if your nutrition program is on target.

Stage of Production	Suggested Body Condition Score
Maintenance	2
Breeding	3
Early Gestation	2+
Late Gestation	3
Lambing	3+
Weaning	2

- Do manage pregnant ewe lambs differently
    - Manage and feed the ewe lambs separately from the older ewes
    - Ewe lambs should be fed to gain 35 to 40 pounds during gestation.
    - Feed for growth as well as pregnancy. Be especially careful not to shortchange them on energy during late pregnancy.
    - Remember her calcium and phosphorous requirements are higher than an older ewe. A free-choice mineral supplement containing calcium, phosphorous, and a trace-mineralized salt should be made available.
    - Feed high quality feedstuffs to the ewe lambs. Avoid low quality roughage.

- Don't underfeed during gestation.
    - Short periods of nutrient restriction or longer periods of mild nutrient restriction during early gestation can reduce placenta growth and ultimately limit lamb birth weight.
    - In late pregnancy the ewe's requirements for energy and protein increase rapidly, especially during the final few weeks of pregnancy. Approximately 70% of the fetal growth occurs during the final six weeks. The difference in a ewe's weight between a single fetus and twin fetuses over this short period can be over 6.5 pounds. Although a ewe will generally be drawing on some body reserves during this time, her tissue weight loss should be more than offset by the increase in weight of the fetus or fetuses plus the uterine fluid weight. As a general rule, a satisfactory level of feeding in late pregnancy should result in a body weight increase over the final eight weeks of about 10% in single-bearing ewes and 18% in ewes carrying twins. A 150 pound ewe carrying twins should increase her body weight by 27 pounds
    - Nutrient restriction during last third of gestation can also reduce colostrum quality and quantity. Coupled with the impact on birth weight, late gestation is critical to lamb vigor and survival.
    - The timing of late gestation supplementation is impacted by fetus number-
      5-6 weeks pre-lambing for ewes carrying triplets
      3-4 weeks pre-lambing for ewes carrying twins
      1-2 weeks pre-lambing ewes carrying singles

- Do feed supplemental energy as needed to avoid pregnancy disease

- Don’t neglect Se and Vitamin E supplementation
    - Selenium and Vitamin E are both critical micro nutrients for lamb survival. Se can be added to sheep feeds at .3 ppm (2.0 ppm is toxic). Selenium crosses the placenta so newborn lamb Se status is a reflection of their dam’s. Vitamin E does not cross the placenta, so the only source for newborns is ewe’s milk or injection. Vitamin E is not toxic so feeding 50-100 IU per day is recommended.

- Don’t increase feed level to ewes while in the lambing pen.

- Don’t use cattle mineral mixes or trace mineral salt. Copper levels are too high and are toxic to sheep.

- Do stop supplementation of the flock 7-14 d before weaning. 48 hr feed and 24 hr water removal at weaning is effective in drying ewes up and reducing mastitis.

Newborn Lamb Management

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At no other time during the year is the investment of time and sound management practices more influential for a sheep producer than during lambing time. The financial success of a sheep operation is largely dependent upon maximizing pounds of lamb weaned per ewe exposed, while minimizing costs of production. Realizing pounds of lamb weaned per ewe is largely dependent on saving the lambs that are born, as the largest percentage of lamb deaths occur at or shortly after birth. The three primary causes of death of lambs around lambing time are difficulty during the birthing process, starvation, and hypothermia. Management practices at lambing time are essential for the economic viability of the sheep operation.

Dystocia (lambing problems) has been shown to be a significant cause of lamb mortality. Losses due to stillbirths and dystocia can be reduced by frequent visits to the lambing barn and timely assistance of ewes. Pregnant ewes should be checked every 3-4 hours. If ewes are checked at 11 p.m. or midnight it is not necessary to check again before 5 or 6 a.m. Ewes that will lamb between these times usually show signs at the late night observation. Ewes close to lambing will be restless and may try to claim other newborn lambs. Ewes in labor will normally separate themselves, and frequently choose a corner or area along a wall or feedbunk to nest and deliver. The lambing area should be dry and well bedded, and sources of cold drafts that will chill newborn lambs should be eliminated. It is not necessary to have a heated lambing barn- a dry, draft-free area is more important. The lambing process can vary considerably between ewes. Ewes in labor should be left undisturbed. However, once the ewe begins forceful straining and the water bags are passed, delivery should normally take place within 45-60 minutes. Once the front legs are visible, lambs should be born within 30-45 minutes. After the first lamb is born, subsequent lambs are normally delivered within 30 minutes. Prolonged delivery beyond these times may indicate lambing difficulty, and the ewe should be examined and assisted if necessary. Prior to assisting the ewe, the examiner should wash the ewe's vulva with mild soap and water. Likewise, the shepherd should thoroughly wash their hands and arms and wear an OB sleeve when assisting or examining a ewe. When assistance is required to deliver one lamb, the uterus should be examined for additional lambs. For lambs that are pulled, a piece of straw may be gently inserted into the nostril as an irritant to help stimulate breathing. Lambs that are delivered rear legs first should be gently shaken upside-down by holding the rear legs to allow fluid to drain from the lungs.

When possible, ewes should be allowed to give birth where they initially bed down. Moving ewes to individual pens when they start lambing may prolong the birthing process and cause other complications. Additionally, allowing ewes to complete the lambing process before moving them to jugs will keep the jugs drier and help prevent injury to lambs in multiple birth situations. Lambing jugs should measure at least 5 ft. x 5 ft., with a maximum slat spacing of 3 in. Large breeds and multiple births may require larger jugs. The environment of the jug is critical to newborn lamb health and survival. The jugs should be kept well bedded, dry, and free of drafts. For facilities with cement floors, a base of lime or sawdust/shavings is recommended under straw. Cement floors can be cold and damp, and therefore a source of chilling and pneumonia in newborn lambs. When feasible, lambing jugs should be cleaned between ewes. Feed troughs and water bucket should be suspended out of the reach of newborn lambs.

The first 24-48 hours after birth are a critical time for the ewe and her lambs. During this time, bonding occurs between the ewe and her lambs. The jugs also assist the shepherd in keeping a close eye on the ewe and lambs during this time. Upon moving the ewe into the jug, the lambs' navels should be clipped and immersed in a 7% iodine solution. Many navels (less than 2 in.) will not need to be clipped. Iodine helps prevent infection and promotes drying of the navel.

Colostrum is the milk produced by the ewe up to 18 hours after birth. It has important nutritional value for the newborn lamb. Colostrum also contains essential antibodies that provide protection against certain diseases for the newborn lamb, and provides energy to keep the lamb warm. Newborn lambs are susceptible to hypothermia due to their large body surface area in relation to body weight, and relatively low energy reserves.

Lambs should receive adequate intakes of colostrum within 30-60 minutes after birth. To help insure this, the ewe's teats should be stripped to remove the wax plugs that frequently obstruct the teat. In some cases, lambs that appear to be nursing may not be getting milk due to these plugs. Stripping the teats will also confirm the ewe has milk. Lambs should be monitored closely to make sure they nurse. Lambs that have nursed will have a full stomach upon palpation. Crutching ewes prior to lambing will enhance the lamb's ability to access the udder, particularly with long-fleeced ewes. Lambs that have not nursed should be assisted. Most lambs have a strong suckling reflex shortly after birth, and will nurse when presented a teat. It may be necessary to close the lamb's mouth on the teat and/or squirt milk in the lamb's mouth to initiate suckling. An effort should be made to help the lamb nurse the ewe before other methods are used to get colostrum into the lamb.

In some cases, the lamb is unable to nurse the ewe even with assistance. These lambs may be small, weak, chilled, rejected by the ewe, or injured. In these cases, stomach tube feeding is necessary to get colostrum into the lamb. Lamb stomach tubes that attach to syringes are available commercially, and should be on hand for all shepherds. Lambs should receive 20 cc colostrum per pound of body weight. As a reference, 30 cc equals approximately 1 oz. Therefore, a 10 lb. lamb should receive 200 cc or about 7 oz. of colostrum in the first 30 minutes after birth. After the initial tube feeding, many lambs will respond and begin to nurse on their own. If not, the lamb may need to be tube fed 2-3 hr. after the initial feeding.

Source of colostrum for these cases is another important consideration. The first choice would be from the lamb's mother. If colostrum is not available from the ewe, another ewe that has just lambed may be a source. It is a good idea to freeze colostrum for future use from ewes that lose their lambs or ewes with singles that are heavy milkers. Colostrum should be pre-measured and frozen using ice cube trays or freezer bags. Frozen colostrum should be thawed with indirect heat (water bath), and not a microwave or direct heat as antibodies will be destroyed. In an emergency, goat or cow colostrum may be used. There are also artificial colostrum substitutes available commercially.

The ewe and her lambs need to be monitored closely the first few days after birth. Healthy lambs are content, and will stretch when getting up and wag their tails when nursing. A gant and weak appearance may be indicative of starvation. Check the ewe to be sure she has milk. In the case of multiple births, the smallest lamb may not be able to compete for the milk supply. Constipation can be a problem in newborn lambs if feces dry and mat down on the tail. Cleaning the area with a damp rag will alleviate this problem.

Time spent in the jug will depend largely on the number of jugs available and rate at which ewes are lambing. Strong, healthy singles may be removed from the jugs in 24-36 hr. after birth, and twins 48 hr. Triplets and ewes with weak lambs may need to stay in the jug for 3 days or more. Ewes and lambs should be removed from the jug as quickly as possible, as chances of pneumonia and diarrhea are greater the longer they are kept confined to the jugs. Labor requirements are also much greater when ewes are confined to the jugs.

Before turning out of jugs, pertinent information on the ewes and lambs should be recorded. Appropriate identification of the lambs (ear tags, paint brands, ear notches, etc.) should also be done at this time. The ability to match a ewe with her lambs can be very beneficial as a management tool. Thin, poor-doing lambs may indicate a health problem in the ewe (mastitis) or inferior milking ability.

Virginia is largely a Selenium deficient state. Deficiency of Selenium and/or Vitamin E causes white muscle disease in lambs. For prevention of this disease and all-around flock health and performance, the ewe flock should be provided a high-selenium complete mineral mix specifically formulated for sheep during gestation (fed free-choice). Additionally, lambs should receive supplemental Vitamin E and Selenium in the first few days after birth.

Upon removal from the jugs, ewes and lambs should be put into a mixing pen with 3-4 other ewes and their lambs. This will help acclimate them, and they should be closely observed to identify abandoned and rejected lambs. After a day or two, the ewes can then be put into larger groups. Lambing jugs should be cleaned and rebedded after each ewe and her lambs are removed. Even though the area may look clean, urine and manure in the pen will release ammonia, which is harmful to the newborn lamb's lungs and can lead to pneumonia. Don't just put down more bedding, remove the old bedding first.

Swine Welfare, Science and Legislation- An Overview[1]

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Introduction

The welfare of swine raised in commercial production systems has been, and continues to be, intensely debated by many groups, including but not limited to consumers, animal activists, scientists, legislators, and farmers. Ultimately, perceptions or misconceptions of welfare issues can dramatically alter pork production if the swine industry response includes abandoning certain production methods or procedures, if governments react by enacting laws dictating how swine are reared, or if consumers reply by boycotting pork. Ideally, when a particular production technique becomes the object of scrutiny, conclusions regarding the welfare of swine and the industry response are based on sound, unbiased scientific information. In this scenario, intervention by legislators is not necessary. It is becoming more and more apparent, however, that governments are yielding to pressure from animal activists and, to a lesser extent, consumers, and have begun instituting policies that affect the rearing of swine. In this situation, it is critical that lawmaker decisions are based on science and not emotion.

Numerous welfare issues face the swine industry. The objective of this paper is to describe two of the more contentious topics: 1.) individual accommodations for gestating sows in crates, and 2.) castration of male pigs. Each issue will be described and the science relative to the issue, pertinent legislation from both world-wide and U.S. perspectives, and swine industry responses discussed. It is important to note that the keeping of sows in crates has been publicly scrutinized and debated for a longer period than the issue of castration procedures, and as a consequence, legislative action and industry responses in the U.S. are more advanced. With that in mind, what has happened thus far with regard to the sow gestation crate issue may perhaps foreshadow developments in the castration issue.

Sow Gestation Crates

Description of the issue. From the perspective of the swine producer, keeping pregnant sows in individual crates offers a number of advantages compared with traditional group-housing systems. For example, care-taking is simpler and signs of morbidity, such as feed refusal or discharge from the reproductive tract are more easily detected. Sows are individually fed and thus, extremes in body weight and body condition can be more easily avoided. Use of individual gestation crates can also maximize the number of sows housed in a gestation barn.

At the beginning of the decade it was estimated that at least 60% of the sows and gilts in the U.S. were kept in crates throughout gestation (Barnett et al., 2001). Typical gestation crates measure 2 feet by 7 feet and limit sows to standing, sitting, and lying. This restricted freedom of movement has been criticized by animal activists who argue that gestation crates do not provide for sow well-being.

[1] *Presented at the Forty-Third Virginia Pork Industry Conference, Franklin, VA, January 29, 2010.*

Science relative to the issue. On the basis of comprehensive reviews of the scientific literature, McGlone et al. (2004) and Curtis et al. (2009) concluded that accommodating sows during the mating and gestation periods in any of a variety of properly designed and operated keeping systems is acceptable from both humane and enterprise points of view. Compared with one another, well-managed crates and group pens each have advantages and disadvantages, but based on holistic assessments of physiology, behavior, performance, and health, generally produce similar states of overall well-being for pregnant sows. Barnett et al. (2001) proposed that a "homeostasis approach" be used for assessing overall animal welfare. This idea for comparing housing or husbandry systems identifies risks to welfare on the basis of changes in behavior and physiology, and corresponding to these changes, decreases in fitness, with fitness defined as the ability to grow, reproduce and survive. An important tenet of the homeostasis approach is that multiple indicators of welfare are assessed.

For example, Estienne et al. (2006) used the homeostasis approach and compared pregnancy rates and litter sizes at day 30 post-mating, body weight changes, backfat thickness, injuries, lameness, display of stereotypies (repetitive, relatively invariable sequences of apparently nonfunctional behaviors such as bar biting), and serum cortisol concentrations in gilts individually kept in crates or grouped in pens of three gilts each. An increase in the secretion of cortisol from the adrenal gland is often used as an indicator of stress in farm animals. Results of this experiment are summarized in Table 1. Various indicators of welfare were either superior in individually-crated gilts, superior in group-penned gilts, or were statistically similar between groups. One measure of fitness favored group pens (i.e., *growth* [body weight change]), while another measure of fitness (i.e., *reproduction* [pregnancy rate]) favored gestation crates. The third measure of fitness (i.e., *survival*) was the same between groups because no sows died during the course of the experiment. Regarding the relative welfare of sows in each system, it is important to note that vastly different conclusions would be obtained if a single, rather than multiple indicators of welfare, was used in the assessment.

Research focusing on the welfare of sows in various production systems continues at various institutions in the U.S. Recently, Estienne and Harper (2009) reported that the type of accommodation to which pregnant gilt are exposed affected subsequent growth and reproduction in female offspring. In general, gilts farrowed by females kept in crates during gestation grew faster and were more feed efficient during the grow-finish phase, were leaner at market weight, but reached puberty later compared with gilts farrowed by females grouped in pens during gestation. To summarize this section, based on a review of available scientific information, it can be concluded that 1.) there is no compelling evidence to suggest that sows kept in well-managed crates during gestation suffer from inherently poor welfare conditions, and 2.) the overall well-being of sows kept in a variety of systems are equal.

Table 1. Indicators of welfare in gilts kept in individual crates (n = 14) or grouped in pens of three gilts each (n = 14 pens) during the first 30 days post-mating (from Estienne et al., 2006).

Item	Crates	Pens	SE	P[1]
Mortality, %	0	0	---	---
Change in body weight, lbs	14.7	24.2	1.8	<0.01
Change in backfat thickness[2], mm	-0.4	-0.3	0.5	NS
Pregnancy rate, %	100	85.7	3.2	<0.01
Number of viable embryos	14.5	13.3	1.7	NS
Injury score[3]				
Head, face, and ears	1.00	2.05	0.15	<0.01
Rump, tail, anus and vulva	0.64	1.45	0.21	<0.01
Legs and feet	0.79	0.62	0.18	NS
Lameness score[4]	0.21	0.57	0.13	0.06
Gilts displaying stereotypies[5], %	92.9	81.0	7.2	NS
Serum cortisol, ng/mL	79.4	57.1	7.8	0.06

[1]Level of statistical significance. $P < 0.05$ considered significant. $0.05 < P < 0.1$ considered a trend for significance. NS = not significantly different ($P \geq 0.1$).
[2]Determined ultrasonically at last rib using Sonograder (Renco Corporation, Minneapolis, MN).
[3]0 to 5 scale: 0 = no blemishes or lesions, 5 = ≥ 5 cuts or small wounds, a severe wound, or severe swelling.
[4]0 to 5 scale: 0 = Even strides, caudal body sways lightly while walking, gilt able to accelerate and change direction rapidly.
[5]Stereotypies observed included floor licking, bar biting, bar licking, vacuum chewing, yawning, and tongue movements.

Legislation relative to the issue. Criticism of individual accommodations for gestating sows by consumers and animal activists began in the 1960's in the United Kingdom and Northern Europe. The tether was banned by the European Union in 2006 and gestation crates will be banned by 2013.

In the U.S., animal activist groups led by *Farm Sanctuary* successfully accumulated the nearly one-half million signatures needed to place a gestation crate ban on the 2002 Florida ballot. Florida voters passed (55% to 45%) the proposed amendment to the state constitution. The ban on the use of sow gestation crates in Florida went into effect in 2008. Since 2002, an additional six states have enacted bans on gestation crates either by ballot initiatives similar to Florida or legislative action. The law recently adopted in Michigan allows pork producers to utilize gestation crates following weaning until sows are confirmed pregnant. A list of states in which there are bans on the use of gestation crates appears in Table 2.

Table 2. States with bans on the use of individual crates for accommodating gestating sows.

			Pork Production	
State	**Year**	**Type**	**Inventory[1]**	**Rank in U.S.**
Florida	2002	ballot initiative	20,000	35th
Arizona	2006	ballot initiative	165,000	27th
Oregon	2007	legislative	20,000	36th
California	2008	ballot initiative	80,000	31th
Colorado	2008	legislative	720,000	16th
Maine	2009	legislative	4,000	43rd
Michigan	2009	legislative	1,020,000	14th
Iowa	NA[2]	NA[2]	19,800,000	1st
North Carolina	NA[2]	NA[2]	9,600,000	2nd
Virginia	NA[2]	NA[2]	350,000	20th

[1]December 1, 2008 (National Pork Board).
[2]NA = Not applicable; Iowa, North Carolina, and Virginia **do not** have bans on the individual keeping of sows in crates but are included here for production comparisons to the states with bans.

In November of 2009, Ohio voters, by a 64% to 36% margin, passed Issue 2, the "Livestock Care Standards Amendment". The amendment was designed to thwart efforts by the Humane Society of the United States to instigate regulation of livestock production methods including the housing of gestating sows, and was the result of a coalition of farmers, agricultural organizations, veterinarians and consumers. A 13-member board that will include three family farmers, two veterinarians, a food safety expert, one representative of a local humane society, two members of statewide farm organizations, two Ohio consumers, and the dean of the Ohio State University College of Agriculture will be formed to develop guidelines for the state. The Humane Society of the United States has already committed to bringing an initiative against modern farming practices to Ohio in 2010.

Swine industry responses to the issue. It is intuitive that animal activist groups initially targeted relatively small hog producing states (Table 2), and those allowing ballot initiatives, in which to instigate bans on the use of gestation crates and gather momentum for more widespread action in larger hog-producing states. In Florida, only two swine operations were impacted by the State's ban and both are now out of business.

Faced with the threat of a ballot initiative supported by animal activist groups, pork producers in Colorado announced they would phase out gestation crates over a ten-year period and acted with lawmakers to initiate a legislative ban of their use. The position of the Colorado Pork Producers Council was that "although animal welfare experts and professional groups have found no one method of housing gestating sows that is clearly better than the other, when managed properly, some concerns have been voiced about the use of individual stalls for pregnant sows" and the action was needed because of "public concerns and changing market conditions". Moreover the Colorado Pork Producers Council stated, "Individual stalls, the standard practice used in the swine industry, are used to provide for the health, safety and well-being for each gestating sow" (National Hog Farmer, 2007).

Finally, in 2007 Smithfield Foods, Inc., the world's largest pork producer and processor, announced plans to begin phasing out gestation crates over the next 10 years (20 years for sow farms on contract with the company). Smithfield officials stated that "both gestation stalls and group housing are acceptable housing practices for sows" and have been "scientifically proven to be humane". The decision, however, "reflects the concerns of the company's customers in the food service and retail sectors" (Feedstuffs, 2007). Shortly after Smithfield's announcement, Maple Leaf Foods, Inc., Canada's largest pork producer, informed shareholders it would gradually phase out sow gestation stalls over the next 10 years and move to group housing of swine. However, last year, Smithfield announced that due to economic conditions it was going to delay plans to replace gestation crates with group housing.

Castration of Pigs

Description of the issue. Compared with gilts and barrows during the grow-finish phase of production, boars have better feed conversion efficiency and live-weight gain and leaner carcasses. Boars, however, have a slightly poorer dressing percentage, which is due to the testes being cut out after slaughter and not included in the carcass weight. Moreover, when intact males are reared together, "riding" by more aggressive individuals in the group is common causing much stress to smaller, submissive boars.

The most important reason why intact males are not raised for slaughter in the U.S. and many other countries, however, is that pork from boars that are nearing sexual maturity has a greater potential for an odor and flavor problem commonly called "boar taint" that is unacceptable to many consumers. Traditionally, pork producers have used surgical castration of male piglets as the primary strategy of controlling boar taint and this method reduces the risk sufficiently for meat from barrows to be routinely sold. Although this procedure has a specific purpose related to animal production, it also causes recognizable pain, and is performed without anesthesia or pain medication. Thus, castration of pigs is becoming a welfare issue that is becoming more highly scrutinized.

Science relative to the issue. Boar taint is caused by two naturally occurring compounds known as androstenone and skatole, the odor of which is said to be comparable to that produced by sweat, urine and feces. Androstenone is a pheromone produced in the testicles once boars have reached sexual maturity. As boars age, androstenone accumulates and is stored in the fatty tissues surrounding muscle. Skatole is a by-product of the microbial activity that occurs naturally in the digestive tracts of both male and female pigs. Gilts and barrows metabolize excess concentrations of skatole, removing it from the body. In boars, the metabolism of skatole is slowed down by the action of reproductive hormones such as testosterone.

In pigs kept in poor sanitary conditions, skatole present in feces can be absorbed through the skin and accumulate in fat. Not all boars will have taint in the meat, and it is important to note that although the incidence and severity is greater in meat from intact, adult males, boar taint can also occur in barrows and gilts at slaughter.

Among consumers there is variation in sensitivity to the presence of taint and in general, women appear to be more sensitive than men. Certain ethnic groups also appear more sensitive than others. Approximately 25% of consumers can not taste the taint chemicals.

As stated above, male pigs destined for slaughter in the U.S. are surgically castrated without anesthesia or pain medication as a method of controlling boar taint. That castration causes a robust stress response is illustrated by an investigation conducted by Prunier et al. (2005). One week-old boars fitted with jugular vein catheters to permit sequential sampling of blood were allocated to one of three experimental groups: castration, sham castration, or no handling. Pigs castrated were restrained between the handler's legs and the anogenital region exposed. Incisions were made on each side of the scrotum to free each testicle from surrounding tissue. The testicles were then removed by cutting the testicular cord. Pigs sham castrated were handled similarly but without any cutting. From 15 to 90 minutes after the start of the procedures, blood levels of cortisol were greater in castrated boars compared to sham-castrated boars or boars that were not handled. The robust increase in cortisol secretion was mainly due to castration itself because the increase in boars subjected to sham castration was of much lower amplitude and duration. The researchers suggested this difference may be related to pain and/or tissue damage.

In terms of other indicators of welfare, McGlone et al. (1993) reported that castration of boars prior to weaning resulted in several behavioral changes including reduced suckling and standing and increased lying times, and these changes were not influenced by treatment with analgesics (aspirin and butorphanol). Decreases in pre-weaning growth due to castration have been reported in many (McGlone et al., 1993; Kielly et al., 1999; Marchant-Forde et al., 2009) but not all (Douet et al., 1995) studies. In addition, studies suggest that age at which castration is

performed on boar pigs can influence the degree of pain experienced and the degree to which welfare may be compromised. For example, one study indicated that pigs castrated at two weeks of age displayed fewer indicators of pain than pigs castrated at seven weeks of age (McGlone and Hellman, 1988). Another study conducted during the suckling period indicated that pigs castrated at one day of age grew at a slower rate to weaning than pigs castrated at 14 days of age (McGlone et al., 1993). Empirical data is lacking but it has been suggested that castration at a very young age (one day of age) may disrupt colostrum consumption and teat order establishment, while castration at advanced ages requires more force to restrain the pig and greater trauma when severing larger, more developed testicular cords. In general, the limited studies reported here support this premise.

It is reasonable to assume that different methods used to perform castration can influence the level of stress or pain imposed. Using behavioral, physiological and performance indicators of welfare, Marchant-Forde et al., 2009 compared two commonly available methods for castrating 2 to 3 day- old boars: 1) scrotal incision and pulling each testicle free from the cord (tearing is believed to minimize bleeding in the process), or 2) cutting each testicle free of the cord. Both methods resulted in substantial high-pitched vocalizations indicating pain. The researchers indicated that greater attention to detail was needed with the tear method to assure gripping and careful pulling to separate the testicle from its cord. As a result, the cord tear method required 96 seconds per pig compared to 70 seconds per pig for the cord cut method. Body weight gain to day 14 of lactation was greater in sham castrated controls (285 g/day) compared to boars castrated using the tear method (233 g/day) with boars castrated using the cut method having an intermediate value (249 g/day) that was not significantly different from the other two groups.

To summarize this section, based on a brief review of scientific literature, there is evidence to suggest that the welfare of baby pigs is compromised, at least for the short term, by castration. It is intuitive that a well-trained, conscientious technician is essential to minimize stress and optimize piglet welfare when castration is performed. Therefore, with practices like piglet castration, the ultimate policy question may be if properly timed, properly performed procedures that cause short term compromises in pig welfare can be justified based on the subsequent pig behavior and pork quality benefits.

Legislation relative to the issue. Since 2002 in Norway, only veterinarians are allowed to castrate piglets. Castration was to be banned completely as of January 2009, but that deadline was deferred. All piglets in the Netherlands must be castrated while under anesthesia, otherwise the pork is not allowed to enter the food chain. In Switzerland, pigs are anesthetized with isoflurane and castrated under veterinary supervision. Castration without anesthesia will be banned there by 2010. Although Denmark is committed to phasing out castration, beginning in 2010, it will be compulsory for piglets to receive pain relief for castration, but not anesthesia.

To our knowledge, at this writing there are no states in the U.S. with legislation pertaining to the issue of castrating boars. The American Veterinary Medical Association's (AVMA) current policy on pig castration, however, acknowledges that castration helps control aggressive behavior in pigs and recommends that the procedure be performed at least five days prior to weaning to allow for sufficient healing before pigs are removed from the sow. The group's policy also indicates that if castration is delayed beyond 28 days of age, anesthesia or analgesia should be used and the procedure should be performed by a veterinarian.

Swine industry responses to the issue. In some European countries, including the United Kingdom and Ireland, castration of boars destined for market is no longer performed. Rather, intact males are sold for slaughter at approximately 200 pounds. At this size, boars have not yet reached the age at which the testicles are producing large quantities of androstenone. All United Kingdom quality-assurance schemes specify that males remain un-castrated, a welfare point that is promoted to the public.

In Australia, New Zealand, Costa Rica, Mexico and Brazil a vaccine called *Improvac* (Pfizer Animal Health) is being used to prevent taint in the meat of boars destined for slaughter. The product stimulates the immune system to produce antibodies against gonadotropin-releasing hormone. This hormone is produced and secreted from the brain of the boar and ultimately drives function of the testicles. *Improvac* causes a decrease in the production of androstenone and skatole. The vaccine involves injections given eight weeks and four weeks prior to slaughter.

Summary

Two welfare issues of current importance to the swine industry are the individual keeping of pregnant sows in crates that limit the animals to standing, sitting and lying, and the castration of boars primarily done as a method of controlling the production of meat with an odor and flavor that is objectionable to many consumers. As these issues are debated, it is critical that decisions of farmers, legislators, and consumers be made based on science and not emotion. The two issues are at very different points in their evolution. Gestation crates for accommodating sows have been banned in many countries of the world and in seven states in the U.S., and some producers have unilaterally opted to discontinue their use, yielding to consumer demands. These actions occurred despite the preponderance of scientific research that showed using holistic assessments of behavior, physiology, health, and performance that gestation crates provide for the well-being of sows and are no less humane than are group-penning systems. If the same sort of holistic assessments are employed to determine the impact of castration on welfare of boars, a different conclusion can be drawn. Based on available physiology, behavior and pre-weaning performance data, the wellbeing of boars is compromised, at least for the short term, by castration without concomitant anesthesia or analgesics. European governments and producers in other countries have responded with various strategies to mitigate or eliminate the decreased welfare associated with castrating pigs. Debate among consumers, animal activists, scientists, legislators, and farmers in the U.S. is forthcoming and how the issue will ultimately be resolved remains to be seen.

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