ARSBC 2012: Inseminator Efficiency & Male Fertility

Under Your Control

Insemination-related factors affecting fertilization in beef cattle.

*by **Troy Smith,** field editor*

University of Idaho animal scientist Joe Dalton discussed insemination-related factors affecting fertilization of beef cattle at the 2012 Applied Reproductive Strategies in Beef Cattle (ARSBC) symposium in Sioux Falls, S.D. Dalton highlighted potential problems due to semen quality, handling of semen, insemination technique and timing of insemination.

Regarding differences in semen-quality traits among sires collected for artificial insemination (AI), Dalton said compensable traits account for reduced fertility when numbers of sperm per insemination are insufficient for normal fertilization. Compensable traits can be overcome or minimized by increasing sperm dosage. Reputable AI organizations routinely adjust the AI dose when compensable deficiencies are known.

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>
> **—Joe Dalton**

Low fertility regardless of sperm dosage is the result of uncompensable traits, and the usual sources are bulls with unacceptable levels of abnormal sperm. Dalton said such bulls should not be collected and used for AI. To reduce risk, he advised sourcing semen from only reputable AI studs.

With application of estrous synchronization and fixed-timed AI protocols, producers often face the challenge of inseminating numerous females within a relatively short period of time. This, said Dalton, raises the question of how many straws of semen may be thawed simultaneously.

"The data suggest that no more semen should be thawed than can be used in 10 to 15 minutes, so technician skill is a factor. You must know your comfort zone," advised Dalton. "Having a lot of females to breed in a short amount of time is a management issue. You have to figure out how to do it without breaking the rules."

PHOTOS BY TROY SMITH

►Low fertility regardless of sperm dosage is the result of uncompensable traits, and the usual sources are bulls with unacceptable levels of abnormal sperm, said Dalton.

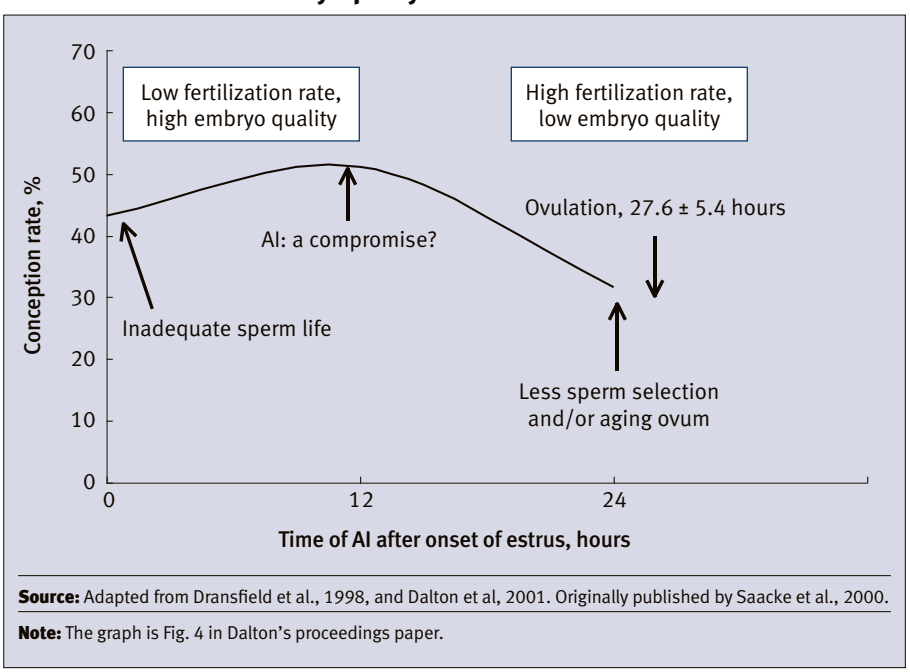
Also related to technician skill is the necessity to deposit semen within the uterine body and not in the cervix. Dalton said deposition in the cervix generally results in a 10% reduction in fertility.

Another factor affecting fertilization is timing of insemination. Sperm require time after insemination for transport and to gain the capacity to fertilize the ovum (egg). However, an ovum that waits too long becomes "aged" and, once fertilized, may produce a low-quality embryo.

"Artificial insemination at 12 hours after the onset of estrus appears to be a compromise between the low fertilization rate and high embryo quality of early insemination and the high fertilization rate but low embryo quality of late inseminations," explained Dalton (see Fig. 1).

Dalton spoke during Monday's ARSBC session focused on inseminator efficiency and male fertility. Visit *www.appliedreprostrategies.com/2012/SiouxFalls/newsroom.html* to listen to his presentation and to view the accompanying PowerPoint slides and proceedings paper.

Fig. 1: AI at 12 hours after onset of estrus appears to be a compromise between the low fertilization rate and high embryo quality of early inseminations and the high fertilization rate and low embryo quality of late inseminations



Source: Adapted from Dransfield et al., 1998, and Dalton et al, 2001. Originally published by Saacke et al., 2000.

Note: The graph is Fig. 4 in Dalton's proceedings paper.

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Start Young

Begin preweaning to manage bull development to optimize fertility.

*by **Troy Smith,** field editor*

Management of nutrition during development of breeding bulls can be a controversial topic. Nearly all discussion is focused on management of bull calves after they are weaned. According to Albert Barth, veterinarian and professor at the University of Saskatchewan's Western College of Veterinary Medicine, nearly all bull development research also has concentrated on the postweaning period. He thinks researchers have overlooked a very important period of development in a bull's lifetime — calfhood.

Studies confirmed that superior calfhood nutrition resulted in higher gonadotropin secretion, resulting in larger testes at a year of age and earlier onset of sperm production.

"I suspect it makes a bigger difference than variations in postweaning nutrition," said Barth. "There are indications of a strong effect of calfhood nutrition and health on age at puberty and testis size, implying earlier maturity and larger lifetime testis size."

Barth said there are limited data explaining the effects of calfhood nutrition. Still, evidence suggests smaller scrotal circumference in yearling bulls raised by first-calf heifers (compared to bulls raised by older dams) may be due to lower milk production of their mothers, fetal programming effects or both. Barth explained how calfhood nutrition affects pituitary gland secretion of gonadotropin hormone. Bull calves experiencing lower gonadotropin secretion are likely destined to mature later and exhibit smaller testes. "It's likely that final testes size is determined before weaning," stated Barth, recommending that management strategies to optimize bull fertility should focus on the time bull calves are still nursing the cow. "Nutrition throughout calfhood and the postweaning period affects age of puberty, but you can't compensate for restricted energy during calfhood."

Barth urged attention to developing practical health and nutrition programs for young bulls, suggesting an ideal nutrition program should be based on breed and frame size. He recommended a program of moderate cost, allowing for growth at 2.5 pounds (lb.) to 3.0 lb. of gain per day, but avoiding excessive body condition. High-energy diets fed postweaning may result in larger scrotal circumference at a year of age, but part of the increased size is probably due to scrotal fat.

►"There are indications of a strong effect of calfhood nutrition and health on age at puberty and testis size, implying earlier maturity and larger lifetime testis size," said Albert Barth.

Barth spoke during Monday's ARSBC session focused on inseminator efficiency and male fertility. Visit *www.appliedreprostrategies.com/2012/SiouxFalls/newsroom.html* to listen to his presentation and to view the accompanying PowerPoint slides and proceedings paper.

Synchronized Natural Breeding

Heat synchronization can be used with natural breeding systems to get more calves born earlier in the calving season.

*by **Shauna Rose Hermel,** editor*

►For natural service incorporating estrous synchronization, Carl Dahlen recommended using experienced bulls 2 years old or older that have high libido and that have passed a satisfactory breeding soundness exam. He recommended a bull-to-female ratio of 1:25.

Natural service still accounts for the large majority of heifers (78%) and cows (94%) bred in the United States, noted Carl Dahlen as he addressed attendees Dec. 3 at the 2012 Applied Reproductive Strategies in Beef Cattle (ARSBC) symposium in Sioux Falls, S.D. "With this in mind, there's some interest in just using bull breeding with estrous synchronization."

Calling this a potential gateway for people to get involved with synchronization, the North Dakota State University beef cattle specialist gave an overview of considerations pertaining to the bull, the cow and estrous synchronization protocols.

Considerations for the bull. One of the questions asked most often is what stocking rate should be used, Dahlen noted, considering three main factors in his response — age, breeding soundness and libido.

During a peak of estrous activity lasting 38-40 hours on synchronized cattle, yearling bulls will have significantly more mounting activity, but they don't necessarily service the cows any more than older bulls, Dahlen said (see Table 1). "To have a successful service, we need three

things: first is an erection, then we have an intermission and then we have an ejaculation."

Yearling bulls, said Dahlen, had significantly less fertility when you look at pregnant cows as a percent of those serviced in a synchronized system.

Breeding soundness exams are a big indicator of fertility and need to be conducted every year, he recommended. Bulls classified as "satisfactory" produced a nearly 10% higher pregnancy rate than bulls classified "questionable."

However, one limitation of breeding soundness exams is that they do not measure libido, which is something producers will need to monitor in the breeding pasture. Libido is affected by breed type, Dahlen said, with *Bos indicus* cattle having lower libido than *Bos taurus* cattle.

Within a 30-hour synchronized period, active *Bos taurus* bulls will breed on average about 60 times, Dahlen said, which brings up the question: Can a bull run out of semen? A mature bull produces about 5 million sperm per minute. Commercially available semen for artificial insemination (AI) contains about 20 million sperm per dose. Apply the math and that calculates to about one dose of semen every 4 minutes.

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Table 1: Impact of bull age

	Bull age		
Item	**1**	**2**	**3+**
Mounts, number	207[x]	120[y]	85.8[y]
Services, number	54.5	37.6	40.5
Estrous females serviced, %	69.4	73.8	72.0
Pregnant of serviced, %	39.6[x]	59.4[y]	62.2[y]
Pregnant overall, %	30.9[x]	41.5[y]	49.9[y]

[x,y]Means in same row with different superscripts differ (P<0.05).

Source: Pexton et al., 1990.

Table 2: Stocking rate

	Bull:heifer ratio			
Item	**1:50**	**1:50**	**1:25**	**1:16**
	Not synched	**Synchronized**		
Bulls per 100 heifers, number	2	2	4	6
Pregnant by Day 6, %	40	38	41	53
Pregnant by Day 28, %	82	77[a]	83	84[b]
Day of conception	10[a]	10[a]	11[a]	8[b]

[a,b]Means in same row with different superscripts differ (P<0.05).

Source: Healy et al., 1993.

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"Overall, the thought is, in mature bulls the semen is not a limiting factor," he concluded.

So what factors are limiting? Bulls "falling in love" and staying by one female. It doesn't happen often, Dahlen said, but things to watch for include 1) few females in estrus, 2) inexperienced bulls shortly after turnout, 3) fatigue toward end of breeding season, and 4) permissive females present in pasture.

"The average female gets bred four times while she is in estrus," Dahlen said, noting a range of 1 to 27. On average 60%-80% of the females in estrus actually get bred. So, the number of services is much greater than the number of females, but 20%-40% of the females don't get bred — even if they are standing right next to the bull while they are in estrus. Later in the breeding season, there are fewer cows to select from and those cows do get bred and become pregnant, he observed.

Dahlen provided an overview of research using different stocking rates on estrous-synchronized heifers. In that study, a stocking rate of 1-to-50 won't cut it, yielding a significantly lower Day 28 pregnancy rate (see Table 2). The economic analysis showed a target of 1-to-25, using bulls that have passed a breeding soundness exam, was the most economical stocking rate.

Based on these considerations, Dahlen recommended using experienced bulls 2 years old or older that have high libido and have passed a satisfactory breeding soundness exam at a stocking rate of 1 bull to 25 cows. Continue to monitor bulls after turnout.

Considerations for the cow. For successful mating, cows need to be in good body condition and at least 40 days postpartum at the start of the heat synchronization protocol, Dahlen said. A low incidence of calving difficulty prior to the program is also important. Cows absolutely have to be cycling, he emphasized.

For further details on setting cows up for a successful synchronized breeding program, Dahlen referred attendees to Michael Smith's 2012 ARSBC presentation.

Synchronization protocols for natural breeding. "Progesterone is present after a CL (corpus luteum) is developed," Dahlen said. "As the life span of that CL goes around, progesterone gets high." Pulses of the prostaglandin (PG) about Day 17 make the CL go away, and progesterone levels fall.

With no intervention and assuming the cows are cycling, 5% of the cows will be in heat each day of a 21-day cycle, meaning 24% will come in heat in the first five days and 48% will come in heat within the first 10 days, Dahlen said, resulting in an average day of conception of Day 10.

Using a one-shot PG protocol to regress mature CLs and bring the cows into heat results in a significantly greater number of cows pregnant within a synchronized window of the first five days, Dahlen noted. However, there was no difference in the overall pregnancy rate at the end of the season. In the same study, there was no difference between using a one-shot PG protocol and a two-shot PG protocol.

Dahlen described a Day 4/5 PG Protocol as one in which you turn the bulls out, then four or five days later give all the cows in the herd an injection of PG. A few will show heat during the first few days. If all are cycling, the remainder will respond to the PG injection, setting the cows up to all show heat within the first 10 days of the breeding season. The protocol resulted in a significantly greater number of cows calving in the first 21 days of the season. In cows, the Day 4 protocol significantly improved the overall calving rate.

Using the 7-day CIDR® protocol essentially stops everything for the seven days the CIDRs are inserted, Dahlen explains. When the CIDRs are pulled, it starts all the cows' estrous cycles over, meaning about 80% of the cattle that are cycling will be in heat within 10 days. Studies have shown CIDRs to initiate cyclicity among cows. While the protocol yielded no differences in pregnancy rates, ultrasound showed that cows receiving the CIDR protocol got pregnant, on average, three days earlier in the breeding season. Whether those three days are worth running the cows through the chute twice and the cost of the CIDRs will differ for each operation, he observed.

Basically any heat synchronization protocol used for AI breeding can be used for natural service, Dahlen noted, but stay away from GnRH (gonadotropin-releasing hormone) near the time of breeding.

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