Back to the Breeding Basics

Liz Eckelkamp, Assistant Professor
Victoria Couture, Graduate Student
Lew Strickland, Associate Professor
Peter Krawczel, Associate Professor
Department of Animal Science

Anytime a sports team does not perform as expected, you may hear the team's coach say, "We are going to go back to the basics." Dairy farms can also apply "basics" to breeding management. Reproduction is often a challenge dairy producers face since selection has typically focused on higher milk production. Selecting for high milk production may have unintended consequences on reproduction. This challenge can be controlled directly by selecting for less fertile animals that have high production or indirectly by not meeting nutritional requirements of dairy cattle. Nutrition, environment and management play key roles in a breeding program [1]. This publication focuses on some overall key performance indicators to evaluate a farm's reproductive success.

Key Performance Indicators (KPIs)

When assessing a breeding program, rely on measurements in terms of goals and challenges. Setting measurable goals, tracking them, and benchmarking to others in a surrounding area can make an operation aware of breeding program strengths and weaknesses. Conception rate, pregnancy rate, estrus (heat) detection rate and days to first service are great tools for monitoring a breeding program. Table 1 lists the average and industry gold standards for some KPIs: pregnancy rate, conception rate, voluntary waiting period, days to first service, observed heats and calving interval. All of these can be calculated by hand and recorded. However, herd management software, such as PCDart or DairyComp305, is an excellent tool for breeding records. These programs automatically calculate or track these variables and can be used to generate reports, breeding lists and other to-do lists for things like timed artificial insemination.

Heat detection rate is the percentage of cows inseminated over a 21-day period divided by the number of cows eligible to be bred over those 21 days [2]. For example, if 10 cows are eligible to be bred but only four are detected in heat, the heat detection rate is 40 percent.

Conception rate is the percentage of cows pregnant divided by the number of cows inseminated during a 21-day period [2]. If two of the cows in the above example become pregnant, the conception rate is 50 percent.

Pregnancy rate is calculated by multiplying the heat detection rate by the conception rate [2]. For the above example, the calculation would be 40 percent multiplied by 50 percent, resulting in a pregnancy rate of 20 percent.

Table 1. Benchmark measurements to determine reproductive success against industry gold standards. Tennessee averages are given for a state reference, not as a gold standard indication. Red cells indicate performance outside of gold standards, which may negatively impact farm reproductive success.

Benchmark Measurement	Average for Tennessee Herds	Industry Gold Standards
Pregnancy rate	16%	20-30%
Conception rate for past 12 months	40% (first service) 40% (total)	35-45%
Voluntary waiting period	57 days	60-75 days
Days to first service	104 days	90-100 days
Heats observed for year	38%	> 50%
Calving interval	14 months	12-13 months

Adapted from DairyMetrics (Dairy Records Management Systems, Raleigh, NC) Tennessee herd averages in August 2018 [3]. Standards reported from Paul Fricke of the University of Wisconsin-Madison, Jeff Stevenson of Kansas State University, and Missouri Dairy Growth Council's Dairy Cattle Reproductive Manual [2, 4].

Although pregnancy rate and conception rate cannot always be controlled directly, a producer can modify factors that will influence them, such as the voluntary waiting period, days to first service and heat detection rate.

Voluntary Waiting Period

Most dairy herds implement a voluntary waiting period (VWP). A voluntary waiting period refers to the number of days following calving that a cow will not be bred, even if she exhibits heat during that time [2]. A cow's reproductive tract requires time to recover following calving, and she is not usually ready to rebreed until two months after calving, roughly 60 days in milk (DIM). The voluntary waiting period gold standard ranges from 60 to 75 DIM. However, new research has suggested a 120- or 180-day VWP can be beneficial for estrus detection and pregnancy, particularly for high-producing cows (≥ 88 lbs production/day). A key consideration in setting a VWP is how quickly after the VWP cows are bred and confirmed pregnant. Farms with excellent heat detection or farms that are excellent at implementing a timed artificial insemination protocol may be able to effectively use a longer VWP. However, VWP must be used in conjunction with additional KPIs to be truly effective. If heat detection rate and conception rate are less than desirable, a longer VWP will likely only increase the length of time cows are open (not pregnant) within an operation.

The opportunity cost of days to confirmed pregnancy can be related in terms of the VWP. This is referred to as the cost of days open (CDO). It includes the cost of feed, housing, labor, veterinary care and semen for a cow for every day past the VWP it takes for her to become pregnant. Every additional day open *past* a herd's individual VWP can cost $0.56 to $5.41, depending on a cow's DIM and parity. As parity and DIM increase, CDO also increases [5]. Keep this in mind when breeding cattle multiple times. A cow that is hard to breed will cost more than just semen and labor, because she is taking up valuable space in the herd.

Some items to consider:

1. Having a VWP within gold standard levels does not ensure good reproductive performance.
2. VWP must be used in conjunction with excellent heat detection or timed artificial insemination.
3. Lengthening the VWP should not be done unless a herd is already excelling reproductively.
4. The cost of days open adds up quickly, decreasing farm efficiency.

Days to First Service

Days to first service is simply the length of time from calving until a cow is inseminated for the first time postpartum. Several factors come into play here. Did this cow have a normal calving or a dystocia? Were there any metabolic disorders? Did her uterus involute properly? How long was the VWP? Was heat detection accurate? Heat detection can be frustrating in the modern dairy operation. Heat stress, lameness, poor footing and overcrowding contribute to reduced estrus (heat) expression and detection. In order to decrease the costs of days open, days to first service should be as close to 60 DIM as possible. If a farm chooses to implement a longer voluntary waiting period, strive for days to first service to be within 21 days of that voluntary waiting period. Developing a focused heat detection protocol and identifying cows that do display estrus is a step toward reducing days to first service.

Heat Detection

Estimations are that approximately 50 percent of heats go undetected, and 15 percent of artificially inseminated cows are not in estrus. Visual observations or effective heat detection devices, such as heat patches, and technologies to monitor behavioral changes associated with estrus can help identify cows in estrus while minimizing days open and the associated economic losses. Visual heat detection includes monitoring the herd for:

1. Standing to be mounted.
2. Being mounted by or mounting other herdmates.
3. Increased activity/fence walking.
4. Increased vocalization.
5. Mucus discharge.
6. Swollen vulva.
7. Chin resting.

Wearable heat detection technologies identify heat based on increased activity. Technologies can measure increased walking time, steps, neck activity or ear activity [6]. Several studies have shown that precision dairy technologies result in similar pregnancy rates as timed artificial insemination protocols [6-8]. Heat patches take advantage of the mounting behavior around estrus. As cows are mounted, the surface of a heat patch will be rubbed off, revealing a different, bright color to help identify cows in heat. However, it is important to know that hot temperatures, slippery footing or health issues can suppress activity and mounting. Any of these conditions can reduce heat detection rate. When visually observing cattle for heat, remember that standing to be mounted is the gold standard for deciding when a cow is ready to be bred.

It is recommended to detect heat at least two times a day, once in the morning and once in the evening. Heat should be detected for at least 20 minutes during a time when cows are not being fed or focusing on another activity such as milking. After detecting a standing heat, the common recommendation has been to breed

according to the a.m./p.m. rule. This means that if the cow was first detected in standing heat in the morning, she should be bred 12 hours later that evening. If she is seen in heat in the afternoon, she should be bred 12 hours later in the morning.

If heat detection twice a day is not possible, consider a modification to the a.m./p.m. rule. If heats are consistently observed once a day, consider breeding within a few hours after observing standing heat since the onset of estrus will be unknown. Waiting 12 hours following a single observed standing estrus may put you outside of the optimum breeding window. If precision dairy technologies are used, most systems suggest a fertility window when a cow should be bred. Use this information when making breeding decisions.

Some factors to consider:

1. Cows must be monitored for heat (estrus) behaviors to improve reproductive success.
2. The best visual detection method is to watch cows twice daily:
    a. Early morning (dawn).
    b. Early evening (dusk).
3. Cows should be bred according to the AM/PM rule UNLESS heats are routinely observed once a day.
4. Precision dairy technologies can effectively replace visual heat detection monitoring of dairy cattle when used correctly.

Timed Artificial Insemination

A timed artificial insemination (TAI) program can minimize heat detection issues, particularly during the summer when fertility and estrus activity may be low or when breeding large groups of cows. Timed AI may also be beneficial when breeding replacement heifers. Heifers can be synchronized and bred to fill gaps in production (i.e., summer) when mature cows may be dried off. Many different programs are available and effective. The key is finding a program that works for you and maintaining it. Timing is everything when it comes to TAI, so make sure to administer shots and breed at the appropriate time. If not followed closely, these programs can be draining on both time and money, as cost per cow ranges from $15–$20, not including labor and semen. Even without using TAI, remember these artificial insemination basics.

1. Thaw semen at 95 F for 45 seconds and maintain a similar temperature throughout handling.
2. Use thawed semen within 15-20 minutes to minimize any decline in quality.
3. Deposit semen in the uterine body. Do this once the tip of the cassou (AI) device is past the last ring of the cervix.

Finally, make sure that the final product — the calf — is worth the effort you put into it. Consider whether the cow herself is still performing well within the herd, keeping in mind that many of her qualities will be passed on to the calf. When evaluating a cow's place in the herd, consider her days in milk at breeding, lactation number, milk production, the cost of that pregnancy, and if she is able to meet or outperform that economic requirement. Once a decision is made that a cow meets the breeding requirements, there are several sire options. For AI, the options are the availability of conventional, sexed or beef semen, as well as the option of using natural service. During the summer, AI is preferred over a bull, because heat stress negatively affects male fertility. Reserve sexed semen for heifers and the genetically superior cows in the herd.

Utilize beef semen for cows who will not be producing replacement heifers, such as those that are likely on their last lactation before leaving the herd.

Many different practices are successful for a variety of farms, so the key is to commit to a protocol that meets the goals of a breeding program. If you have any questions, please contact your Extension agent (visit extension.tennessee.edu/Pages/Office-Locations.aspx to find yours); Liz Eckelkamp at eeckelka@utk.edu, 865-974-8167; or Lew Strickland at lstrick5@utk.edu, 865-974-3538.

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