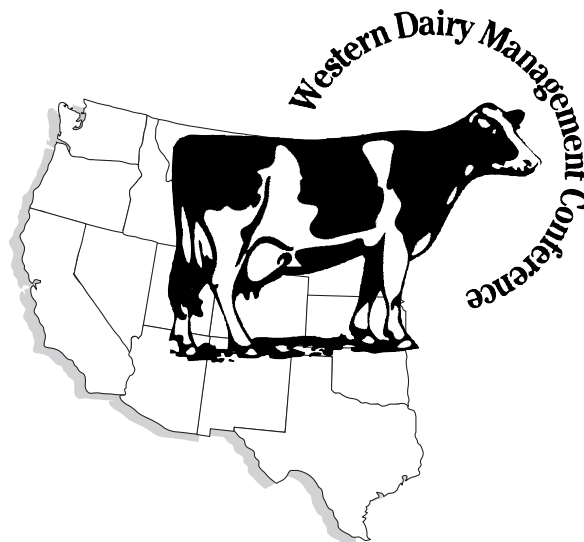# Improving Pregnancy Rates In High Producing Herds

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Improving Pregnancy Rates In High Producing Herds

The reproductive performance of US dairy herds has decreased markedly in the last decade. Information from cow records processed at the DHI Computing Services, Inc., Provo, UT gives insight into magnitude of changes the have occurred in herd reproductive performance in the last decade.

The days open of herds processed in Provo have increased from 128.2 days in 1989 to 149.7 days in 1998. This is an increase of 21.5 days, 15 days of which have occurred since 1994. In February of 1994, rBST was introduced into the marketplace. The use of rBST has resulted in increased milk production and allowed producers more time to get cows pregnant.

From a management perspective, the three primary factors that control days open are days-in-milk (DIM) at first breeding, efficiency of heat detection and fertility. Days-in-milk at first breeding has increased from 80.8 days in 1989 to 84.8 in 1998, an increase of 4 days. Fertility is measured as either conception rate or services per conception. Services per conception have increased from 2.04 in 1989 to 2.25 services in 1998. On the basis of 0.4 more services per conception, the reduction in fertility accounts for an additional 4.4 days to days open. Services per conception are the average number of services for cows that conceive and fails to include cows that do not conceive or become "do not breed" cows. In other words, services per conception are an overly optimistic measure of fertility.

The increase in service per conception does not establish a cause-effect relationship between rBST and infertility but rather suggests that cows treated with rBST produce more milk and with the additional milk production, dairy producers have obtained additional time to inseminate these cows.

The efficiency of heat detection can be estimated by calculating the intervals between breedings from DIM at first breeding to conception. The estimated effi-ciency of heat detection has decreased from 46.1% in 1989 to 40.4% in 1998, a decrease of 5.7 percentage points for efficiency of heat detection.

The effect of the decreased efficiency of heat detection on days open can be calculated by assuming that the remainder of the increase in days open after the effects of the increased DIM at first breeding and infertility are take out is due to the decreased efficiency of heat detection. If 8.4 days of the 21.5 day increase in days open can be attributed to greater DIM at first breeding and reduced fertility, the remaining 13.5 day increase in days open must be due to failures in heat detection. These changes indicate a reduction in all the common measures of reproductive performance of US dairy herds.

Several problems exist in using averages to measure reproductive performance of individual herds. Averages may suffer from significant lag. The effect of a change in a management practice that affects days open may not be reflected in the average days open for the herd for several months.

Many of the averages used to measure reproductive performance have bias built in the measure. Services per conception is biased toward a more favorable view of the fertility of the dairy herd, since only those cows that conceive enter into the calculation, ignoring the undesirable outcomes of open and repeat breeding cows. Culling and the deliberate exclusion of "do not breed" cows from many of the reproductive calculations can markedly alter the accurate expression of the dairy's true reproductive status.

An even larger problem of using averages to characterize reproductive performance is that averages fail to describe the distribution or variation about the mean. The degree of variation is key to evaluating a dairy herds reproductive performance.

For example, average days open of 120 may be very acceptable if all cows conceive between 80 and 150 days. However, if the spread is from 45 to 250 days, there may be a significant reproductive

problem in the herd and a large percentage of cows may eventually be removed from the herd as reproductive culls. A wide distribution of days open may be the equivalent of standing with one foot in a bucket of hot water and other in a bucket of cold water. The average temperature is acceptable but the extremes may not be tolerable.

In spite of the fact that DIM at first breeding has increased, many dairies have lowered their voluntary waiting period to 40 or 45 DIM as a strategy to reduce days open. With short voluntary waiting periods, some cows conceive very early in lactation while many cows still conceive too late in lactation, and the average days open may have improved only slightly. If cows that conceive at less than 55 DIM have calving intervals of less than 11 months, one has to ask if it is desirable to obtain calving to conception intervals of less than 55 days and calving intervals of less than 11 months.

In addition to short calving intervals, a frequent consequence of short voluntary waiting periods is that the fertility of cows bred in early lactation is lower than cows bred later in lactation at 75 or more DIM. The efficiency of heat detection has decreased by 5.7 percentage points in the last decade.

It is unclear as to what factors have adversely affected the efficiency of heat detection. The efficiency of heat detection is a calculated value based on the intervals between heats and/or breedings and in no way reflects on the accuracy of heat detection. In fact, if the number of breedings to cows not in estrus increased, the efficiency of heat detection would increase but fertility of the herd would decline.

The impact of culling cows for reproductive reasons is a frequently overlooked factor that affects the common measures of reproductive performance for the herd. If cows with excessive days open are either culled from the herd or given a "do not breed" status, the parameters that are measures of herd reproductive performance can be improved artificially.

By using averages to measure herd reproductive performance, averages fail to give an adequate perspective of the true reproductive status of the herd. Days open, average DIM at first service and services per conception are all calculated averages but they fail to convey a perspective of the distribution or variation of each of the reproductive parameters.

Poor reproductive performance of dairy herds has multiple consequences. Actual milk production is reduced below the herd's potential as average DIM increases. The amount of milk lost with increasing average DIM is difficult to quantify because of interactions with parity of the cows, season, and use of rBST. Cows that either fail to become pregnant or become pregnant too late in lactation to justify retention in the herd may be culled for either reproductive reasons or low production. The result is a higher rate of forced culling for poor reproduction, lower production and the loss of the opportunity to remove cows with low relative value from the herd as elective culls and replace them with heifers that have greater production potential.

The forced removal of good cows from the herd that have experienced reproductive failure restricts genetic progress when cows with high genetic merit leave the herd for reproductive reasons. Genetic progress is also reduced when natural service sires of unknown genetic value are used to solve herd reproductive problems.

A 1996 NAHMS survey reported that 26.7% of the cows culled from US dairy herds are culled for reproductive reasons. Another 22.4% of the cows culled leave for poor production. The distinction between culling for reproductive reasons and poor production is frequently blurred. However, it means that at least 10 % of the average herd is culled annually for reproductive reasons.

At current prices received for cull cows and the cost of producing or purchasing replacement heifers, I would suggest that every time a cow is culled for reproductive reasons, the producer incurs a cost of at least a thousand dollars for each cow culled. With an average annual reproductive culling rate of 10%, the average annual cost for reproductive culling exceeds one hundred dollars per cow. In addition to the cost of culling, the decrease in reproductive performance results in the availability of fewer replacement heifers. A 21.5 day increase in days open suggests that there has been a 5% reduction in the supply of replacement heifers produced by the milk herd over the last decade.

Pregnancy Rate Drives Reproductive Performance of Dairy Herds

Historically, producers and veterinarians have focused on heat detection efficiency and concep-

tion rate independent of each other as the drivers that control herd reproductive performance. Pregnancy rate is gaining acceptance as a better measure of reproductive performance for the dairy herd. Pregnancy rate combines conception rate and the rate of heat detection as a measure of herd reproductive performance. Pregnancy rate is calculated by multiplying the rate of heat detection in a 21day period of time by the conception rate. Pregnancy rate is time dependent in that it is the percentage of cows that become pregnant in one estrous cycle. Since pregnancy rate has a time component, it can be used to monitor the distribution of pregnancies that occur over time with graphs called survival curves.

Figure 1 shows the survival curve for a herd with a voluntary waiting period of 60 days and a 16% pregnancy rate. The median days open are about 130 days. Of more concern, however, is the fact that 30% of the normal, healthy cows are still open at 200 DIM.

There is nothing wrong with these cows. They are just victims of a 16% pregnancy rate and their risk of becoming reproductive culls has increased markedly. Under most circumstance, only the cows detected in estrus are inseminated. Conception rate is the proportion of cows that are inseminated that become pregnant.

Currently, the average efficiency of heat detection for US dairy herds is about 40%. This means that an average dairy producer would detect 40 cows in heat in a group of 100 cows eligible for breeding in the period of one estrous cycle. Current conception rates for US dairy herds are about 40%.

This means that 40% of the 40 cows detected in estrus would conceive and the pregnancy rate for the group would be 16%.

If the pregnancy rate is to be improved, either the percentage of cows eligible for insemination that are actually inseminated must be increased or the conception rate for the cows inseminated must be increased or both must be improved. The first estrous cycle after the voluntary waiting period offers the greatest opportunity for getting the highest absolute numbers of cows pregnant in one estrous cycle.

The potential number of cows that could become pregnant in one estrous cycle will never be greater than in the first estrous cycle following the voluntary waiting period. With each subsequent estrous cycle, as some of the cows become pregnant, the number of eligible cows continues to decrease with each subsequent estrous cycle. In addition to the number of cows eligible for pregnancy, only in the first estrous cycle following the voluntary waiting period are all of the cows eligible to enter an estrous synchronization or controlled breeding program.

With any estrous synchronization program that has a timed insemination component, 100% of the cows can be inseminated following the voluntary waiting period. Depending upon the frequency with which cows are inducted into the synchronization program, it is theoretically possible to have one hundred percent of the cows bred in the first week following the voluntary waiting period if eligible cows are inducted on a weekly basis.

The greatest potential improvement in pregnancy rate occurs by increasing the proportion of cows that are inseminated during the first estrous cycle following the voluntary waiting period from the average of 40% that are currently detected in heat to an insemination rate of 100%. An estrous synchronization program could increase the insemination rate to 100% by either using an estrous synchronization program that exclusively uses timed insemination, or a program that uses a combination of estrous detection followed by timed insemination. If conception rate remained constant, the theoretical pregnancy rate would have increased from the current rate of 16% to at least a rate of 40%.

With current estrous synchronization programs

Survival Curve for Days Open for Average US Dairy Herd

Figure 1
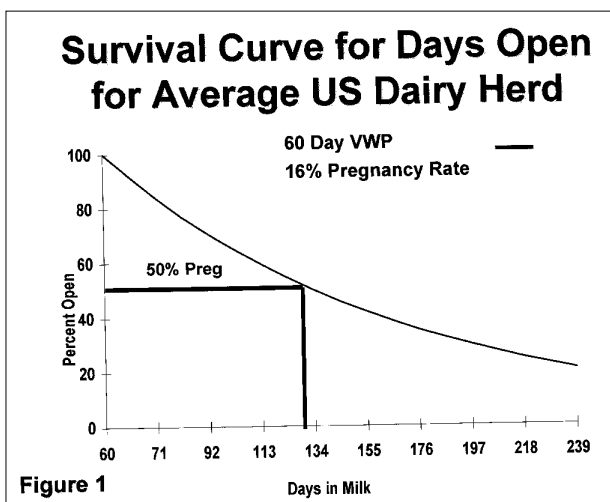
followed by timed insemination, conception rates have been slightly depressed compared to cows inseminate on the basis of detected estrus; thus conception and pregnancy rates have averaged between 30 and 35%. This is still twice the current pregnancy rate for the average U.S. dairy herd on the first estrous cycle following the voluntary waiting period. On the other hand, it seems likely that the current average conception rate of 40% could be increased to between 45 and 50% by applying those management practices and technologies that improve conception rates.

If we only successfully applied the management practices and technologies that enhance conception rates without improving the rate of submission to insemination, the pregnancy rate would only increase from the current 16% to 20%. However, by implementing a program that results in a 100% service rate and using the currently available management practices and technologies to enhance the conception rates, a producer could attain a 50% pregnancy rate for cows inseminated in the first estrous cycle following the voluntary waiting period! This would be a 3-fold increase in the current pregnancy rate for the first estrous cycle following the voluntary waiting period.

The potential benefits of a program achieved a 50% pregnancy rate during the first estrous cycle after the voluntary waiting period are multiple (Figure 2.). The median days open are less than 85 days and the percentage of the herd that is open at 200 DIM is reduced from 30% with a 16% pregnancy rate to about 15% with a 50% pregnancy rate of the first estrous cycle and 16% pregnancy rate on subsequent cycles. Essentially the number of normal cows that are open at 200 DIM is halved!

The program would result in a reduction of the median DIM resulting in greater milk production. There would a reduction in the number of cows culled for reproductive reasons. Greater genetic progress achieved with more cows becoming pregnant through artificial insemination to proven sires or young A.I. sires. There would be more replacement heifers available.

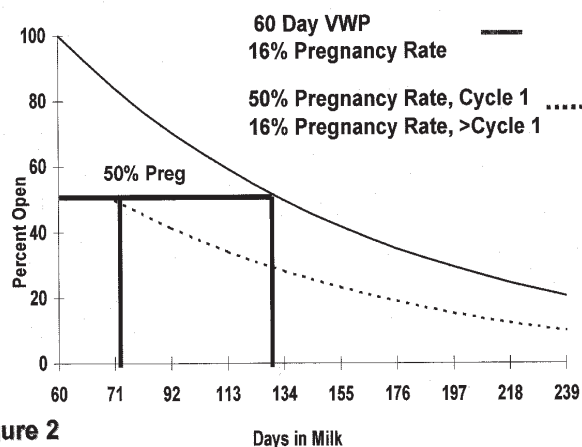## Survival Curve for Days Open with 50% PR Cycle 1

Figure 2
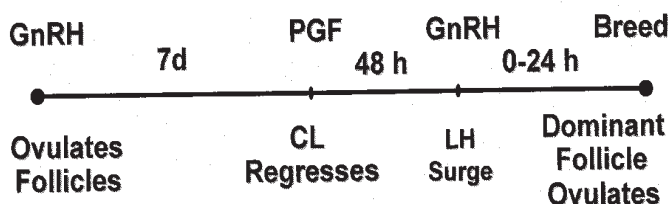
Ovsynch[R] Program

Figure 3

Estrous Synchronization Programs With Timed Artificial Insemination

Numerous estrous synchronization programs have been based on the use luteolytic prostaglandin (PGF2a). The most frequent objection to these programs was that the synchrony of estrus was not tight enough to allow for timed artificial insemination (TAI) and achieve acceptable conception rates.

The primary reason for the lack of synchrony of estrus with PGF2a is the variability in the stage of the ovarian follicular waves at initiation of PGF2a treatment. Researchers have developed a better understanding of the dynamics of ovarian follicular waves and have used GnRH to control follicular wave development to improve estrous synchrony. This has allowed for the development of estrous

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synchronization programs using GnRH in conjunc-tion with PGF2a which have achieved acceptable pregnancy rates with either exclusive TAI or a com-bination of estrous detection and TAI.

OvsynchR/TAI Program

In 1995, Pursely, et al., reported on a new method of synchronizing the time of ovulation in dairy using GnRH and PGF2a. This estrous syn-chronization program with TAI is referred as the OvsynchR program. The program consists of an initial injection of GnRH followed in 7 days by an injection of PGF2a. Forty-eight hours following the PGF2a injection, cows receive a second GnRH injection followed by TAI (Figures 3 and 4.). The interval from the second GnRH to the

TAI has varied from insemination at the time of the second GnRH injection up to 32 hours after the injection. Initially, the highest pregnancy rates were reported for TAI occurring at 16 to 18 hours after the second GnRH injection when preg-nancy deter-mination was done by ultrasound at 28 to 30 d post-breeding. However, the rate of loss of preg-nancies increased as the interval from the second GnRH to TAI increased (Table 1). The net result was that there was no difference in calving rates for intervals from the second GnRH injection to TAI up to 24 hours post injection.

There are two interesting observations on the display of estrus in the OvsynchR program. First, in trials where estrous detection has occurred in the interval between the injection of PGF2a and GnRH, approximately 10% of treated cows have been detected in heat. Second, within a few hours following the second GnRH injection, the cows cease to display estrus as serum progesterone levels began to rise. Pregnancy rates for the OvsynchR program have been reported in the literature to average between 30 and 35%.

Producers have objected to the cost of drugs for the OvsynchR program. Fricke, et al., 1998, recently reported that the results of using a half dose of the CystorelinR brand of GnRH were equiva-lent to using a full dose. This practice could markedly reduce the cost of the program. All estrous synchroni-zation programs with TAI should be compared on the basis of the cost per pregnancy and include drugs, labor, and semen.

Presynch Program

Thatcher, et al., 1998, reported on a modification to the OvsynchR program they had developed to enhance the pregnancy rate obtained with the OvsynchR program. Thatcher's modification of the OvsynchR program was based on the observation that pregnancy rate was affected by the day of the estrous cycle the cow was at when she received the first GnRH injection.

Injection Schedule for Ovsynch[R] Program

Figure 4

Injection Schedule for Presynch Program

Figure 6

Reproductive Parameters of Cows Inseminated at Varying Intervals Following 2nd GnRH

	Time from Second GnRH until AI					
	0 h	8 h	16 h	24 h	32 h	Total
Cows, no.	149	148	149	143	143	732
Preg/AI, %	37	41	45	41	32	39
Preg Loss %	9**	21	21	21	32**	22
Calving Rate %	31	31	33	29	20	29

Table 1   **Pursley, et al, 1998 JDS 81:2139**

Cows that were between days 5 to 12 of the estrous cycle when treatment was initiated had the higher pregnancy rates than cows at other stages of the estrous cycle.

By strategically placing two injections of PGF2a 26 and 14 days prior to the first injection of GnRH in the OvsynchR program, the majority of cows are between days 5 and 12 of the estrous cycle at time of the first GnRH injection (Figure 5 and 6). Thatcher, et al., 1998, called this the Presynch program and reported that the pregnancy rate for 274 cows treated with the OvsynchR program was 37.7% compared to 46.9% for 260 cows treated with the Presynch program.

Modified Targeted Breeding Program

Pharmacia & Upjohn has developed a core estrous synchronization pro-gram consisting of 3 injections of hormones followed by a period of observation for estrus with TAI at the conclusion of the observation period. The program is initiated with a PGF2a injection followed in 14 days by an injection of GnRH. The initial PGF2a injection increases the proportion of cows that are between days 5 and 12 of the estrous cycle at the time of the GnRH injection.

Seven days after the GnRH injection, cows receive a second PGF2a injection. Cows are observed for estrus for 72-80 hr and bred on the basis of observed estrus. For the cows that have not been observed in estrus by 72 to 80 hr following the PGF2a injection, breeding is by TAI (Figure 7 and 8). The program has the flexibility to allow for a second injection of GnRH 48 hr after the second PGF2a injection for the producer that prefers an exclusive TAI program.

Enhancing Conception Rate

Conception rate is influenced by the health of the postpartum cow. In the immediate postpartum period, cows are at increased risk for developing a number of diseases. These diseases include milk fever, retained fetal membranes, metritis, mastitis, ketosis, fatty liver infiltration, displacement of the abomasum, and ruminal acidosis. These diseases adversely affect reproductive performance and increase the risk that cows developing these diseases will be culled.

To minimize the effects these diseases have on reproductive performance of cows, it is important for producers to imple-

Figure 7

Figure 5
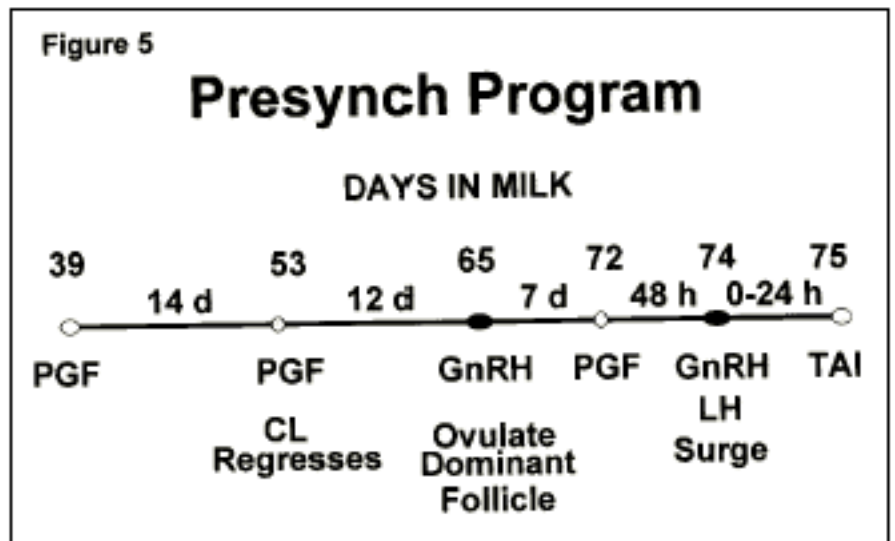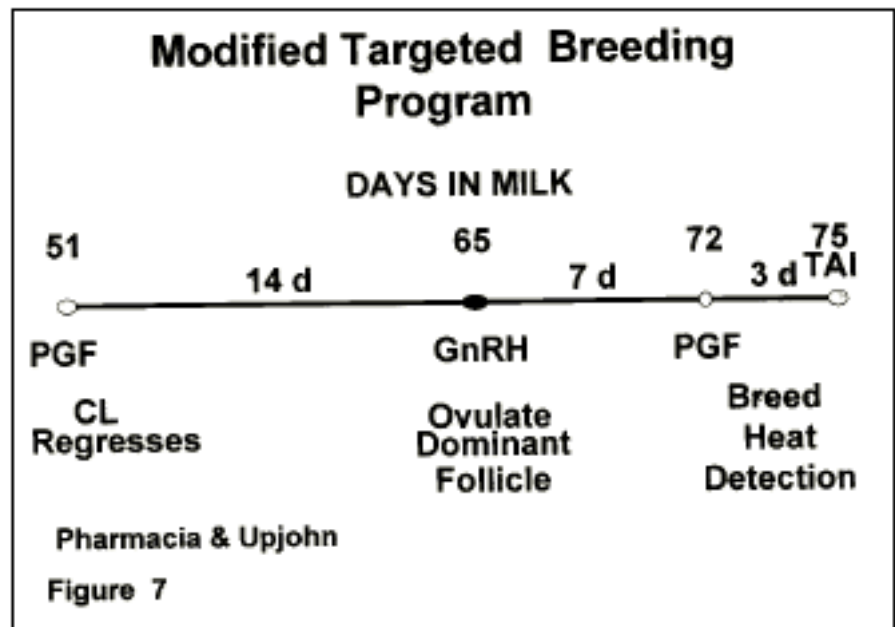
ment effective measures to prevent these diseases. Since even with the implementation of the effective preventative measures, these diseases can not be entirely eliminated, it is also important to develop protocols to identify these disease as early as possible and treat them effectively.

Days-In-Milk At First Service

The DIM when cows are bred following an estrous synchronization program with TAI affects the pregnancy rate. Pursley et al., 1997, observed a significant improvement in pregnancy rate from 26% for cows receiving TAI between 60 and 75 DIM compared to 43.4% for cows receiving TAI at greater than 75 DIM. In a second trial, Pursley et al., 1998, reported a trend for the improvement of the pregnancy rate of 36% for cows receiv-

-ing timed A.I. between 50 and 75 DIM compared to 47% for cows receiving timed A.I. between76 and 100 DIM.

With the ability to select which post partum week that cows are inseminated following a controlled breeding program with TAI, there may be some advantages in extending the voluntary waiting period to at least 75 DIM. The obvious advantage is that there may be a 10% or greater improvement in pregnancy rate. The second advantage is that a greater proportion of cows could have closer to a twelve month calving interval with the elimination of short calving intervals as a result of cows conceiving early following short voluntary waiting periods. These two advantages should be given consideration in selecting longer voluntary waiting periods to be used in conjunction with a controlled breeding program.

Effect of Energy Status on Pregnancy Rate

The most important nutritional factor affecting conception rate is the energy status of the dairy cow in the interval between calving and first service. Several studies have demonstrated that an excessive cumulative negative energy balance in the postpartum period is associated with a reduction in the first service conception rate.

Cumulative changes in energy balance in the postpartum period can be measured indirectly by monitoring changes in body condition from calving to 45 DIM. Most studies suggest that the loss of one unit of body condition score or greater is associated with a reduction in first service conception rate. In 1998, Moreira, et al., reported that the pregnancy rate to TAI was significantly reduced for cows with body condition scores of less than 2.5 at the time of insemination. The pregnancy rate for cows with body condition scores of <2.5 at TAI was 11.1% compared to 25.6% for cows with body condition scores > 2.5 at TAI. The guidelines relative to body condition score to maximize pregnancy rate are: 1) The loss of body condition between calving and 45 DIM should not exceed 1 condition score. 2) The lowest acceptable body condition score at the time of insemination is 2.5 without negatively affecting pregnancy rate.

These observations suggest that the critical points to monitor body condition are at the time of calving, at the time of first insemination and possibly at 45 DIM.

Effect Of Semen Handling And Inseminator On Conception Rate

Several things can happen with respect to semen handling and insemination that can adversely affect pregnancy rates when estrous synchronization-TAI programs are implemented. When faced with that task of breeding large numbers of cows that have been synchronized for TAI, inseminators often look for short cuts to hasten the process of getting the cows bred.

One of the most frequent short cuts I have observed is for inseminators to thaw multiply units of semen, load several guns and head out to the pen or lot to breed cows. Lee, et al., 1997, observed that the conception dropped from 47.6% for the first service number when multiple units were concurrently thawed to 25.0% for the fourth service in the batch thaw. Conception was reduced by 50% from the 1st unit to the 4th unit of semen inseminated in a batch! This trial was conducted in Hawaii where cold shock of semen should have been minimal when compared to most anywhere else in the U.S.

On larger dairies, people who rarely inseminate cows are frequently recruited to help breed cows following estrous synchronization-TAI programs. This presents a problem in that these people are often less skilled and lack sufficient practice to be proficient. In addition, arm fatigue becomes a problem and the accuracy of site of semen deposition is reduced.

All these factors can reduce the pregnancy rate. Management needs to appreciate this problem and help by providing equipment and facilities so semen can be thawed one unit at time and used before the next unit is thawed. Frequently these needs can be met by providing a vehicle to carry a liquid nitrogen canister and a battery operated thaw unit that is available close to the cows.

Monitoring Success Of Estrous Synchronization Programs With TAI

Producers frequently measure the success of breeding programs by monitoring percentage of cows pregnant of those presented for pregnancy diagnosis on scheduled herd reproductive examination.

nation. The herd examination is usually considered a success when 85% or more of the cows presented for pregnancy diagnosis are pregnant. This measurement of success is no longer applicable with the use of estrous synchronization programs and TAI. More cows will be inseminated, more cows will become pregnant earlier in lactation, but more cows will be open at pregnancy examine. Success needs to be based on pregnancy rate to the synchronized estrus and TAI, not the percent cows pregnant on reproductive examinations. Monitoring procedures need to be developed to monitor the pregnancy rate of a monthly cohort of cows.

References:

•1. Fricke, P.M., J.N. Guether, and M.C. Wiltbank. 1998. Efficacy of decreasing the dose of GnRH used in a protocol for synchronization of ovulation and timed A.I. in lactating dairy cows. Theriogenology 50:1275-1284.

2. Lee, C.N., T.Z. Huang, and A.B. Sagayaga. 1997. Conception rates in dairy cattle is affected by the number of semen straws thawed for breeding. J. Dairy Sci. 80(Suppl 1):151

3. Moreira, F., C. Risco, M.F.A. Pires, J.D. Ambrose. M. Drost, M. DeLorenzo, and W.W. Thatcher. 1998. Effect of body condition on reproductive efficiency of lactating dairy cows receiving a timed insemination. J. Dairy Sci. 81(Suppl 1):215

4. Pursley, J.R., M.O. Mee, and M.C. Wiltbank. 1995. Synchronization of ovulation in dairy cows using PGF2a and GnRH. Theriogenology 44:915-932.

5. Pursley, J.R., R.W. Silcox, and M.C. Wiltbank. 1998. Effect of time of artificial insemination on pregnancy rates, calving rates, pregnancy loss and gender ratio after synchronization of ovulation in lactating dairy cows. J. Dairy Sci. 81:2139-2144.

6. Pursley, J.R., M.C. Wiltbank, J.S. Stevenson, J.S. Ottobre, H.A. Garverick, and L.L. Anderson. 1997. Pregnancy rates per artificial insemination for cows and heifers inseminated at a synchronized ovulation or synchronized estrus. J. Dairy. Sci. 80:295-300.

7. Thatcher, W.W., C.A. Risco, and F. Moreira. 1998. Practical manipulation of the estrous cycle in animals. Proc. 31st Annual Mtg. AABP 31:34-50

 8. Vasconcelos, J.L.M., R.W. Silcox, G.J. Rosa, J.R. Pursley, and M.C. Wiltbank. 1997. Synchronization rate, size of the ovulatory follicle, and conception rate after synchronization of ovulation with GnRH on different days of the estrous cycle. J. Dairy Sci. 80(Suppl 1):178

Notes

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