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COSTS AND COMPARISONS OF ESTROUS SYNCHRONIZATION SYSTEMS

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Introduction

To incorporate desired genetics into cattle breeding programs, producers have an increasing number of options available for synchronization of estrus or ovulation and artificial insemination (AI). Low-cost production continues to be essential for survival in the beef industry. Understanding the costs of producing pregnancies via various methods and their associated value is very important. For some, the need to do more than turn a bull out with the cows is sufficient analysis for them to not consider AI. Others will take a broader view of the issue and may find AI is a tool that can improve profitability.

This paper examines the costs associated with producing pregnancies via natural service and various estrous synchronization systems. Some parts of the process are relatively easy to assign costs and make comparisons, whereas for others, assigning economic values is much more difficult. As always, to make the most informed decisions, each producer must know costs of production for their own operation.

Cost of Natural Service

Understanding the costs associated with natural service breeding is a good place to begin. The original purchase price, bull to cow ratio and years of use are all-important factors that affect breeding costs. Table 1 shows annual bull ownership costs and estimated costs per pregnancy for a range of bull purchase prices ($1,500 to $3,000) and bull to cow ratios (1:15 to 1:50). For reference, the American Angus Association reported the average price of Angus bulls sold for fiscal years 2000 to 2003 was $2290. Annual bull costs were adapted from the 2003 Kansas Cow-Calf Enterprise Budget cost estimates and annual bull costs were separated using the method of Kasari et al. (1996). Additional assumptions included: the use of each bull for four breeding seasons; 10% death loss; 7% interest rate; and a 94% pregnancy rate. Annual feed costs for cow herds vary by as much as $200 per cow and this same variability is expected in feed costs for bulls. Increasing annual feed costs by $100, increased cost per pregnancy by $7.34 for a low bull to cow ratio (15 cows/yr) and $2.21 for heavy bull use (50 cows/yr), given a $2,300 purchase price.

Producers who use breeding pastures with carrying capacities less than the serving capacity of the bull, will increase cost per pregnancy. Conversely, cost per pregnancy will be reduced if highly fertile bulls are identified and exposed to more females compared to more conservative recommendations.

Cost of Synchronization of Estrus Plus AI

The partial budget in Table 2 gives an overview of cost differences between an AI program and natural service. Compared to natural service, increased costs of an AI program included synchronization products, labor for synchronization of estrus and AI, time for planning, and perhaps improvements in facilities. Decreased returns include income from the sale of cull bulls because fewer bulls will be needed. Depending on the size and management of the operation, costs could be decreased by having fewer bulls to purchase, maintain, and keep out of trouble, less time and labor for calving in a shorter calving season, and less calving assistance from high-accuracy, low-calving-difficulty bulls. Income will increase as a result of more older, heavier calves at weaning. Producers with good marketing skills also will increase returns from a more uniform calf crop and by producing offspring with genetics that are in demand. If replacement heifers are generated from within the herd, long-term benefits may accrue from selection for

Table 1. Annual bull costs ($) based on purchase price and associated cost per pregnancy.

Purchase price	1,500.00	1,700.00	2,000.00	2,300.00	2,500.00	3,000.00
Salvage value	896.00	896.00	896.00	896.00	896.00	896.00
Summer pasture	174.00	174.00	174.00	174.00	174.00	174.00
Crop residue	8.50	8.50	8.50	8.50	8.50	8.50
Hay	102.98	102.98	102.98	102.98	102.98	102.98
Protein, mineral	25.00	25.00	25.00	25.00	25.00	25.00
Labor	50.00	50.00	50.00	50.00	50.00	50.00
Vet	40.00	40.00	40.00	40.00	40.00	40.00
Repairs	31.00	31.00	31.00	31.00	31.00	31.00
Misc.	7.00	7.00	7.00	7.00	7.00	7.00
Interest	15.35	15.35	15.35	15.35	15.35	15.35
Total variable	453.83	453.83	453.83	453.83	453.83	453.83
Deprec. on equipment	12.39	12.39	12.39	12.39	12.39	12.39
Deprec. on bull	150.85	200.85	275.85	350.85	400.85	525.85
Interest on bull	83.88	90.88	101.38	111.88	118.88	136.38
Death loss	15.00	17.00	20.00	23.00	25.00	30.00
Total fixed	262.12	321.12	409.62	498.12	557.12	704.62
Total cost/yr	715.95	774.95	863.45	951.95	1,010.95	1,158.45

Purchase price	1,500.00	1,700.00	2,000.00	2,300.00	2,500.00	3,000.00
Cows Exposed Per Year			Cost per pregnancy			
15	50.78	54.96	61.24	67.51	71.70	82.16
20	38.08	41.22	45.93	50.64	53.77	61.62
25	30.47	32.98	36.74	40.51	43.02	49.30
30	25.39	27.48	30.62	33.76	35.85	41.08
35	21.76	23.55	26.24	28.93	30.73	35.21
40	19.04	20.61	22.96	25.32	26.89	30.81
50	15.23	16.49	18.37	20.25	21.51	24.65

traits such as milk production or longevity. The beneficial items in our budget (i.e., improved genetics, more concentrated calving season) are much more difficult to value, and some might not be captured by producers without additional marketing efforts. Nevertheless, in a marketplace that is increasingly value driven, the opportunity to capture this genetic value will expand in the future.

Table 2. Partial budget for synchronization of estrus plus AI

Budget Effect	Source	Budget Effect	Source
Increased returns	Heavier calves (earlier average birth date) Improved genetics (calves and replacement females) Uniformity of calf crop (fewer sires could be used, total breeding season could be shorter)	Decreased returns	Fewer cull bulls to sell
Decreased costs	Fewer bulls to purchase and maintain Less labor for more concentrated calving season More predictable calving ease	Increased costs	Planning and management for synchronization of estrus and AI Synchronization products and supplies Labor Improved facilities?

An example of the potential value of improved genetics is in Table 3. Carcass characteristics and boxed beef values from Angus sires with 10 or more carcass data records are illustrated. The carcass value was $206 per head greater for sires grouped in the top 10% than the bottom 10% for carcass value. It is clear a few more dollars could be invested in breeding costs to produce a product worth $206 more at harvest. Because the industry has been selling commodity cattle based on average values for so long, it is difficult for many producers to market calves so they are paid for the true value of the genetics produced. Currently, these value differences are more readily observed at harvest than weaning, but the trend is toward identifying and rewarding known genetics earlier in the production process. Excellent marketing is one of four keys for high returns on assets for cow/calf enterprises in the Northern Great Plains (Dunn, 2000).

Table 3. Average carcass characteristics and boxed beef values for Angus sires with 10 or more carcass data records*

Trait	Top 10%	Bottom 10%	Difference
No. of progeny	2728	1751	
No. of sires	109	110	
% Prime	7.7	0.7	+7.0
% CAB	47.4	.7	+46.7
% Choice & above	93.7	48.1	+45.6
% Select	6.1	35.0	-28.9
% Standard	0.2	16.9	-16.7
% YG 1&2	60.0	38.2	+21.8
% YG 4&5	1.4	18.2	-16.8
Carcass price/cwt	$110.19	$94.15	$16.04
Carcass value	$822.27	$616.36	**$205.91**

*Source: Angus Beef Bulletin, January 2000.

As the beef industry continues to shift from a commodity market to a value-based market, differences in costs and returns for various breeding systems may be more readily calculated. If the cost per pregnancy is higher for a particular method of breeding, what are the chances those costs can be recouped achieving higher marketing returns on the superior genetics? This example illustrates the complex decision-making framework that exists in the cow/calf industry today.

Whole Herd Cost of Pregnancy

To evaluate breeding costs under different breeding systems, estimates of the hours of labor required for various synchronization systems were obtained from a survey of beef producers using AI in Nebraska (Loseke, 1989). From that survey, regression equations were estimated for total labor hours required for various AI programs.

Nonsynchronized program:

$$TM = 19 + .036(CD) \qquad R^2 = .83$$

Lutalyse synchronization program:

$$TM = 2.65\,(CD)^{.5} \qquad R^2 = .60$$

SyncroMate-B synchronization program:

$$TM = 2.53\,(CD)^{.5} \qquad R^2 = .87$$

TM = Total hours of labor required for AI program
C = Total number of cows and heifers being bred AI
D = Total number of days in AI program

The labor equation for the SyncroMate-B system was used for all the estrous synchronization systems in this report. Breeding systems were evaluated for various herd sizes. Breeding herds of 35, 116, and 348 head allowed for culling of nonpregnant and physically impaired cows to yield 30-, 100-, and 300-head calving herds. For the current model, costs were estimated over a range of AI-pregnancy rates. Pregnancy rate to AI was multiplied by number of cows, and the product was divided by an average conception rate of 70% to get the number of cows in estrus. Cows and heifers not pregnant to AI were exposed to bulls for the remainder of the breeding season. Pregnancy rate for the total breeding season was 94%. The number of bulls required for clean-up was based on the assumption 50% would conceive to AI and that one bull was used per 30 nonpregnant females. This approach to the number of clean-up bulls reflects a decision on number of bulls needed must be made before the AI pregnancy rate is known. Variable and fixed costs for AI are shown in Table 4. Synchronization product costs represent the average of 30 sources for both GnRH and $PGF_{2\alpha}$ products available on internet sites. The annual interest rate charged for cash costs was 7%. The labor rate used was $10.77 per hour (Fogleman et al). Annual bull costs ($2,300 purchase price) were $952 per bull as illustrated in the Table 1. Budget

Table 4. Artificial insemination costs

Item	Cost per unit ($)
Semen	14.00 – straw
Prostaglandin $F_{2\alpha}$	2.54 – dose
GnRH	3.21 – dose
CIDR	9.02 - dose
Supplies	0.50 – insemination
Fixed costs[a]	175.00

[a]Semen tank, carrying case, pipette gun, thaw box, and liquid nitrogen

items from the partial budget in Table 2 not accounted for in this model include value of AI-sired replacement heifers, more concentrated calving season, more predictable calving ease, and any facility improvements.

Cost per pregnant female as calculated in this model reflects costs for both AI and natural service pregnancies. As AI pregnancy rate is reduced without changing the number of bulls required for natural service, cost per pregnancy actually decreases because of lower costs for semen and interest for a system where only cows observed in estrus are inseminated. While this reduction would mean fewer AI-sired calves, the impact of that reduction would depend on how well the producer capitalizes on the genetic value of the calves and is not reflected in the cost per pregnant female. To understand the impact of number of bulls used for cleanup on the cost of the system, the number of clean-up bulls was varied in Table 5. An additional bull for natural service adds from $8.73 per pregnant female for herds of 100 head and only $2.91 for herds of 300 head. As the AI pregnancy rate increases, the percentage of costs due to semen expense increases and those attributed to the bull decrease. At what might be considered typical AI pregnancy rates, approximately 50%, bull costs easily represent the largest share of costs followed by semen costs. The importance of annual bull costs to the total cost of the breeding system would be further emphasized with bulls with a higher initial purchase price. For smaller herds especially, the number of bulls used has a significant effect on costs of the breeding system. Successfully identifying bulls that can reliably service more than the 30 cows used in this example would be extremely valuable.

Table 5. Effect of changing pregnancy rate on breeding cost per pregnant female in a Select Synch protocol.

Calving herd size	AI pregnancy rate	No. of bulls for natural service	Breeding cost per pregnant female	% of total cost attributed to:			
				Bulls	Semen	Labor	Treatments
100 hd	75%	1	$42.75	20%	37%	19%	14%
	75%	2	$51.48	34%	31%	16%	12%
	50%	2	$45.59	38%	23%	18%	13%
	40%	2	$43.23	40%	20%	19%	14%
	40%	3	$51.96	50%	16%	16%	12%
300 hd	57%	5	$39.77	37%	30%	12%	15%
	57%	6	$42.68	41%	28%	11%	14%
	50%	6	$41.03	43%	26%	11%	15%
	40%	6	$38.67	45%	22%	12%	16%
	40%	7	$41.58	49%	20%	11%	15%

A better evaluation of breeding systems would be to account for the proportion of pregnancies from AI or natural service in each system. To do this, calves with AI sires were assigned a value of $25 per head greater than those born to natural service. The AI sired calves would be on average 10 days older and 20 lb heavier at weaning, thus increasing the return at weaning by $25, if the additional weight is worth $1.25/lb. For this model, calves sired by AI sires were valued at $525 per head, and natural service sired calves were valued at $500 per head. To compare breeding system costs and returns, a standardized production scale was generated. Breeding system costs per exposed female were reduced for any increased revenue from AI-sired calves and expressed as a 500-lb equivalent, weaned-calf, breeding cost per hundred (cwt). A weaned calf crop of 82% was assumed.

Breeding system costs and the standardized cost per cwt for various breeding systems assuming equivalent AI pregnancy rates (50%) are in Table 9. Breeding system costs per pregnant female were least for natural service followed by MGA + PGF, MGA-Select and Select Synch; CO-Synch + CIDR was most expensive. On a standardized production scale, 500-lb equivalent weaned-calf breeding cost per cwt, several systems have costs less than natural service. These include MGA + PGF, MGA Select, and Select Synch for all herd sizes and include 7-11 Synch for a herd size of 300. So, decisions based strictly on cost and not the returns generated by those costs, may be erroneous. Systems with the highest standardized cost per hundred involve CIDRs and/or timed AI. The difference in cost per cwt between MGA + PGF and natural service was \$2.08/cwt and \$1.65/cwt, for herd sizes of 300 and 30, respectively. The difference in cost per hundred between natural service and MGA + PGF indicates the amount the breakeven price for weaned calves would need to change to account for differences in breeding system costs and number of AI pregnancies. Therefore, the weaning breakeven price must be \$2.08/cwt greater for a natural service breeding system than one using MGA + PGF to generate equal returns with all else being equal. The CO-Synch+CIDR system standardized cost per hundred was \$2.52 and \$3.36 more than natural service for herd sizes of 30 and 100, respectively. The common factors among those systems with the lowest standardized costs seem to be low treatment costs, heat detection and estrus AI, and relatively higher labor costs. A comparison in this manor assumes additional labor to facilitate the heat detection and AI is either readily available or can be hired. If competent help can be hired to complete the task, then that would seem to be the most economical method to use. Some cannot or will not hire outside help, in which case the opportunity cost of the time spent on AI may be perceived to be too great compared to other farming or ranching activities.

In comparing a timed AI system such as CO-Synch to Select Synch where cows are inseminated after an observed estrus, the standardized costs per cwt are less with the Select Synch system, and the difference is greatest for the largest herd size. Therefore, although in most cases estrus-AI may produce more pregnancies with less cost, timed AI may allow a producer to use AI who would not have considered AI if heat detection was necessary. This situation may occur because of herd size, a pasture too large for efficient heat detection, or if labor was unavailable. This type of producer may have a greater ability to recover the additional cost of timed AI in the value received for the genetics produced.

A further examination of the Select Synch and CO-Synch systems at varying labor and semen costs is shown in Table 6. For the herd size of 30, there are several situations where the breeding costs per cwt are less for CO-Synch than Select Synch. These include at low semen costs and medium to high labor costs, at medium semen cost and medium to high labor costs at a 60% AI pregnancy rate and at the highest semen and labor costs at an AI pregnancy rate of 60%. For a herd size of 100 (data not shown), the only situation where the cost of Co-Synch is less than Select Synch is for the low semen cost and high labor cost and 60% AI pregnancy rate (difference of \$0.14). The differences in cost per cwt between CO-Synch and Select Synch are greatest when semen costs are high. For a herd size of 300, there are no combinations where the costs are less for CO-Synch. Averaged across all herd sizes and AI pregnancy rates, and at the highest labor cost, the standardized cost for Select Synch is \$0.62/cwt less than CO-Synch and this increases to \$1.44/cwt at low labor costs. At the lowest semen cost, averaged across all herd sizes and AI pregnancy rates, the advantage of Select Synch over CO-Synch is only $0.29 and increases to $1.78/cwt at high semen costs.

Table 6. 500 lb equivalent weaned calf breeding costs per cwt for a herd size of 30 at various labor and semen costs

System	Preg. Rate (%)	Semen cost ($)								
		4/unit			14/unit			24/unit		
		Labor Cost ($/hour)								
		5.77	10.77	15.77	5.77	10.77	15.77	5.77	10.77	15.77
CO-Synch	40	10.44	11.34	12.24	13.05	13.95	14.85	15.66	16.56	17.46
CO-Synch	50	9.92	10.82	11.73	12.53	13.43	14.34	15.14	16.04	16.95
CO-Synch	60	9.41	10.31	11.21	12.02	12.92	13.82	14.63	15.53	16.43
Select Synch	40	9.86	11.42	12.99	11.35	12.91	14.48	12.84	14.40	15.97
Select Synch	50	9.51	11.08	12.64	11.37	12.94	14.50	13.24	14.80	16.37
Select Synch	60	9.16	10.73	12.29	11.40	12.97	14.53	13.64	15.20	16.77

Pregnancy rates to AI will vary based on a variety of factors and the effect of changing pregnancy rate on the standardized cost per cwt was calculated within each system (Table 10). Notice for a herd size of 30 using CO-Synch, the cost per pregnant female remains the same despite differences in AI pregnancy rates. This is because all animals are treated and inseminated, one bull is still needed for clean up and total number of cows pregnant at the end of the entire breeding season is similar. The benefit of more AI pregnancies is reflected in the standardized production scale.

Table 10 allows a comparison of systems at different AI pregnancy rate outcomes. Comparing Select Synch to Select Synch + CIDR, the CIDR allows for two fewer days of heat detection and should increase pregnancy rates over Select Synch, particularly in anestrous cows. However, even at a 60% pregnancy rate for the Select Synch + CIDR, the cost per cwt is still less for a Select Synch system yielding a 40% pregnancy rate. MGA-Select requires one additional injection of GnRH and one more day of labor than MGA + PGF. Costs per cwt for MGA + PGF at a 40% pregnancy rate are less than a 50% pregnancy rate with MGA + Select. CO-Synch and MGA-Select +TAI have very similar costs and returns, because there is little added cost with the MGA-Select +TAI in this model. This is based on the assumption there is no additional labor cost to deliver the MGA, and the MGA carrier is part of the normal ration. A comparison of giving PGF on the day before CIDR removal (CIDR + PGF6) or at CIDR removal (CIDR + PGF7) indicates the CIDR + PGF7 system reduces cost from $0.90 to $0.28 per pregnant female for herd sizes of 30 to 300, respectively and reduces cost per hundred $0.21 to $0.07.

Economies of scale are evident in these results, however breeding costs are just part of the picture. Both Kansas SPA and Farm Management databases indicate well managed small herds can be as profitable as large herds.

Another Look at Labor Costs

To verify the estimates of labor required for AI in the model developed by Loseke, (1989), a survey of producers using AI was conducted at the 2003 Range Beef Cow Symposium, Mitchell, NE. Comparisons of the labor cost (all at $10.77/hour) between the Loseke model and that estimated from the Range Beef Cow Symposium (RBC) survey are show in Table 7. Cost per pregnancy determined by the survey estimate is lower for herd sizes of 30 but slightly higher for herd sizes of 100 and 300. Given the variability of conditions these estimates are intended to represent, the "average" values are fairly close especially when compared on a breeding cost per hundred basis.

Limited survey information was collected on costs associated with hiring outside labor to do all AI and heat detection. Technicians surveyed represent the states of Kansas, Nebraska, Colorado and Missouri. Technicians were asked to estimate the costs associated with an operation 30 miles from their base location, "good facilities" and no semen sales involved. Scheduling of smaller herds, especially with no semen sales involved may be a problem during peak season. For days when extra help was required beyond the technician, most had people they called on for help in the price range of $100 to $150 (with horse) per day. Costs were higher for herd sizes of 100 and 300 when priced in this fashion. Technicians were also asked to estimate a cost per head to inseminate in a strict timed AI setting. The insemination cost per head was $7 to $10, $5 to $10 and $3.5 to $6.5 for herd sizes of 30, 100 and 300, respectively. Higher prices are not unheard of in the author's own experience, particularly when facility quality is lower.

Table 7. Comparisons of labor costs from three different sources* for a Select Synch breeding system resulting in a 50% AI pregnancy rate.

	Total Labor cost ($)			Cost per pregnancy ($)			500 lb equivalent weaned calf breeding cost ($) per hundred		
Herd Size	Loseke Model	RBC Survey	AI Tech Survey	Loseke Model	RBC Survey	AI Tech Survey	Loseke Model	RBC Survey	AI Tech Survey
30	484	369	463	67.66	64.19	67.03	12.94	12.14	12.80
100	880	965	1243	45.59	46.36	48.91	7.88	8.06	8.64
300	1525	2186	2997	41.03	43.05	45.53	6.83	7.30	7.87

*Loseke, 1989, RBC Survey – Date collected at 2003 Range Beef Cow Symposium, AI Tech survey – responses from a limited number of commercial AI technicians

Pregnancy Rates to AI

The costs and returns based on various AI pregnancy rates and estrous synchronization systems have been shown. The question then becomes, what pregnancy rate can be expected from various systems in my herd? Age, body condition, and days postpartum will all impact the proportion of cows cycling at the onset of the breeding season and thus the pregnancy rate to AI. AI-pregnancy rates will vary widely for the same synchronization system. Table 8 depicts ranges in pregnancy rates that might be expected during a 5-day AI period or a single timed AI (CO-Synch). The value under the "typical" column is a conservative estimate that might be used for planning in **well-managed herds** with optimal conditions.

Table 8. Pregnancy rates (%) to a 5-day AI period or a single timed insemination*				
	Heifers		Cows	
	Range	Typical	Range	Typical
MGA + PGF	40-70	60	40-60	55
MGA Select	40-65	60	40-65	60
MGA + TAI*			45-65	60
Select Synch	40-65	50	35-55	50
CO-Synch*	-		30-55	50
CO-Synch+CIDR*	30-80	50	30-70	50
CIDR + PGF7	40-80	50	35-60	50
7-11 Synch	30-55		35-65	
2 × PGF	30-65	50	20-45	40

Exercise caution when evaluating field reports of pregnancy rates from various systems. In some cases, only part of the herd (mature or early calving cows) was studied. This may be a wise and practical way to implement an AI program, but the results will likely be better than when the entire herd is synchronized. The method of determining AI pregnancies also may be misleading. To ensure clear distinction between AI and natural service pregnancies, a common research practice is to wait at least 10 days after AI before turning out bulls for clean-up in order to make an accurate early pregnancy diagnosis (30 to 40 days after first AI). Even with this 10 day break in breeding, known AI-sired calves have been born on the same day as natural service sired calves.

It is clear reliable estrous synchronization systems exist that produce AI pregnancy rates of 50% or more with a single timed AI. Producers who refine their management in preparation for the breeding season, identify highly fertile bulls for both AI and natural service, and have a gradually increasing percentage of cows calving early will find even better results over time.

Other Factors to Consider in Protocol Selection

Although costs of a breeding system are important, other factors should be considered when selecting a synchronization protocol. For example, the duration or complexity of a system may make it a bad choice for certain situations even though it looks good on paper. The model described here does not account for such things as the likelihood that the proper treatment will be given on the correct day or that the facilities are adequate to allow detection of estrus and sorting of breeding females and their calves.

The proportion of heifers or cows expected to be cycling at the start of treatments will be a major factor in synchronization success and thus is also important in protocol selection. Systems that incorporate MGA, GnRH or CIDRs and/or calf removal should be considered for groups of animals where anestrus may be a problem. In many MGA systems, the MGA is delivered before some of the anestrous animals are ready to respond to the induction. Both GnRH and CIDRs provide a progestin exposure just prior to the start of the breeding season, however some animals may not have a follicle large enough to respond to GnRH. Insertion of CIDRs ensures every animal receives the progestin exposure. While the CIDR works well on anestrous animals the added treatment cost may be hard to justify for cycling animals. Selective administration of CIDRS to animals that are late calving, thin or young may be a good compromise.

Other considerations in protocol selection include length of treatment protocol as it relates to other management issues (i.e., movement to summer pastures), ability and facilities to detect heat, ability and ease of treatment administration (i.e., can MGA be fed?), and prior experience with AI or synchronization. Further discussion of the various synchronization systems and associated strengths and weaknesses can be found in other papers in this proceedings.

Conclusions

Cost per pregnancy is often used to evaluate various breeding systems but it fails to account for added value from AI sired calves. When even a small value is associated with an AI-sired calf, several synchronization systems have standardized production costs lower than natural service. While timed AI systems are in demand by producers, if labor is available and heat detection is feasible, cost analyses indicate AI after estrus rather than timed AI should produce greater returns. Some timed AI systems have standardized costs similar to natural service at a 50% pregnancy rate and lower costs at 60% depending on herd size. Given all the demands on the CEO's of today's cow-calf herds, hiring highly skilled, specialized people to apply estrous synchronization systems and AI makes good sense. Particularly for someone just starting an estrous synchronization program, experienced help may be worth a lot to the success of a program. The planning required to schedule help is a problem for some, but should be a priority.

A variety of synchronization systems are available to fit a range of production settings and requirements for implementation. Producers that can identify and market high value genetics will profit most from this technology.

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Figure 1. Diagram of systems for synchronization of estrus included in cost analysis

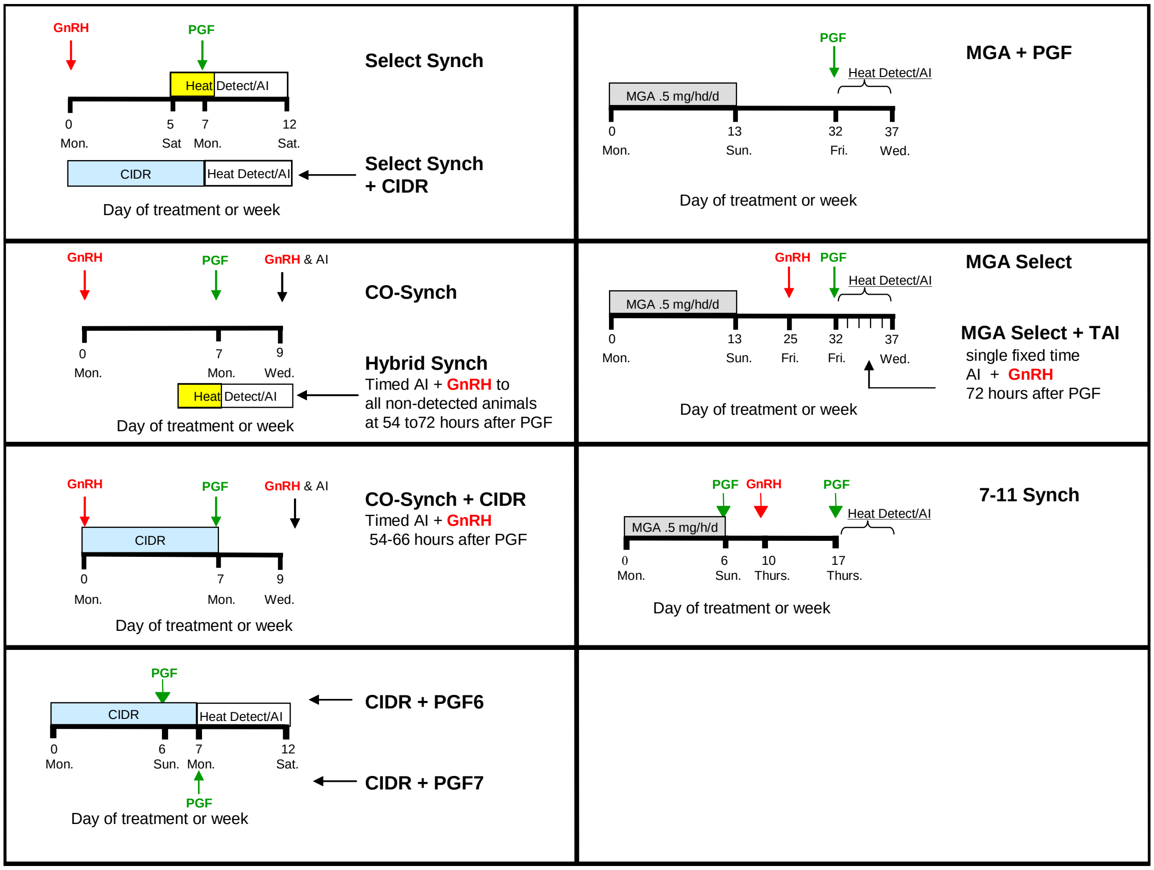

Table 9. Breeding system costs and 500 lb equivalent weaned calf breeding cost per cwt.

System*	Days worked	Preg. rate (%)	Total labor hours			No.of bulls			Cost ($) per pregnancy			500 lb equivalent weaned calf breeding cost ($) per cwt					
			Herd size														
			30	100	300	30	100	300	30	100	300	30	Diff[a]	100	Diff[a]	300	Diff[a]
Natural Service						2	4	12	58	35	35	**13.27**	-	**8.01**	-	**8.01**	-
MGA/PGF	6	50	37	67	116	1	2	6	62	41	37	11.61	1.65	6.83	1.17	5.93	2.08
MGA Select	7	50	40	72	125	1	2	6	66	45	41	12.67	0.60	7.79	0.22	6.84	1.17
Select Synch	9	50	45	82	142	1	2	6	68	46	41	12.94	0.33	7.88	0.13	6.83	1.17
7-11 Synch	8	50	42	77	133	1	2	6	70	48	44	13.47	(0.21)	8.50	(0.49)	7.50	0.51
CO-Synch	3	50	26	47	82	1	2	6	70	51	47	13.43	(0.17)	9.02	(1.01)	8.30	(0.29)
MGA-Select + TAI	3	50	26	47	82	1	2	6	70	51	48	13.56	(0.30)	9.15	(1.14)	8.43	(0.43)
CIDR+PGF d7	7	50	40	72	125	1	2	6	73	51	47	14.06	(0.79)	9.18	(1.17)	8.22	(0.22)
Hybrid Synch	7	50	40	72	125	1	2	6	73	52	47	14.13	(0.86)	9.24	(1.24)	8.12	(0.12)
CIDR+PGFd6	8	50	42	77	133	1	2	6	73	52	47	14.26	(1.00)	9.29	(1.28)	8.29	(0.28)
Select Synch +CIDR	7	50	40	72	125	1	2	6	76	55	51	14.90	(1.63)	10.01	(2.01)	9.06	(1.06)
CO-Synch + CIDR	3	50	26	47	82	1	2	5	80	61	55	15.79	(2.52)	11.37	(3.36)	9.99	(1.98)

*Descriptions of these systems are shown in Figure 1.
**Assumes 40% of cows bred based on observed estrus (no GnRH at AI)
[a]Diff=difference between natural service and breeding system, $/cwt

Table 10. Breeding system costs ($) and 500 lb equivalent weaned calf breeding cost ($) per cwt at various AI pregnancy rates.

System*	Days worked	Preg. rate (%)	No. of bulls			Cost ($) per pregnancy			500 lb equivalent weaned calf breeding cost ($) per hundred					
			Herd size											
			30	100	300	30	100	300	30	Diff[a]	100	Diff[a]	300	Diff[a]
Natural Service			2	4	12	58	35	35	13.27	-	8.01	-	8.01	-
CO-Synch	3	40	1	2	6	70	51	47	13.95	(0.68)	9.53	(1.52)	8.82	(0.81)
	3	50	1	2	6	70	51	47	13.43	(0.17)	9.02	(1.01)	8.30	(0.29)
	3	60	1	2	6	70	51	47	12.92	0.35	8.50	(0.49)	7.79	0.22
MGA-Select + TAI	3	40	1	2	6	70	51	48	14.08	(0.81)	9.66	(1.65)	8.95	(0.94)
	3	50	1	2	6	70	51	48	13.56	(0.30)	9.15	(1.14)	8.43	(0.43)
	3	60	1	2	6	70	51	48	13.05	0.22	8.63	(0.62)	7.92	0.09
CO-Synch+ CIDR	3	40	1	2	5	80	61	55	16.30	(3.03)	11.88	(3.88)	10.50	(2.50)
	3	50	1	2	5	80	61	55	15.79	(2.52)	11.37	(3.36)	9.99	(1.98)
	3	60	1	2	5	80	61	55	15.27	(2.01)	10.85	(2.85)	9.47	(1.47)
MGA/PGF	6	40	1	2	6	60	39	35	11.59	1.68	6.81	1.20	5.90	2.10
	6	50	1	2	6	62	41	37	11.61	1.65	6.83	1.17	5.93	2.08
	6	60	1	2	6	64	43	39	11.64	1.63	6.86	1.15	5.96	2.05
MGA Select	7	40	1	2	6	64	43	39	12.65	0.62	7.76	0.24	6.81	1.19
	7	50	1	2	6	66	45	41	12.67	0.60	7.79	0.22	6.84	1.17
	7	60	1	2	6	69	48	43	12.70	0.57	7.82	0.19	6.86	1.14
CIDR+PGF7	7	40	1	2	6	70	49	45	14.03	(0.76)	9.15	(1.14)	8.20	(0.19)
	7	50	1	2	6	73	51	47	14.06	(0.79)	9.18	(1.17)	8.22	(0.22)
	7	60	1	2	6	75	54	49	14.08	(0.82)	9.20	(1.20)	8.25	(0.24)
Select Synch+CIDR	7	40	1	2	6	74	53	48	14.87	(1.60)	9.99	(1.98)	9.04	(1.03)
	7	50	1	2	6	76	55	51	14.90	(1.63)	10.01	(2.01)	9.06	(1.06)
	7	60	1	2	6	79	57	53	14.92	(1.65)	10.04	(2.03)	9.09	(1.08)
Hybrid Synch	7	40	1	2	6	73	52	47	14.64	(1.37)	9.76	(1.75)	8.64	(0.63)
	7	50	1	2	6	73	52	47	14.13	(0.86)	9.24	(1.24)	8.12	(0.12)
	7	60	1	2	6	73	52	47	13.61	(0.34)	8.73	(0.72)	7.61	0.40
7-11 Synch	8	40	1	2	6	68	46	42	13.45	(0.18)	8.47	(0.47)	7.47	0.53
	8	50	1	2	6	70	48	44	13.47	(0.21)	8.50	(0.49)	7.50	0.51
	8	60	1	2	6	72	51	46	13.50	(0.23)	8.53	(0.52)	7.53	0.48
CIDR+PGF6	8	40	1	2	6	71	49	45	14.24	(0.97)	9.26	(1.26)	8.26	(0.26)
	8	50	1	2	6	73	52	47	14.26	(1.00)	9.29	(1.28)	8.29	(0.28)
	8	60	1	2	6	76	54	50	14.29	(1.02)	9.32	(1.31)	8.32	(0.31)
Select Synch	9	40	1	2	6	65	43	39	12.91	0.35	7.85	0.15	6.81	1.20
	9	50	1	2	6	68	46	41	12.94	0.33	7.88	0.13	6.83	1.17
	9	60	1	2	6	70	48	43	12.97	0.30	7.90	0.10	6.86	1.15

[a]Diff=difference between natural service and breeding system, $/cwt *-See Figure 1 for descriptions of system

NOTES