INCREASING THE ODDS FOR SUCCESSFUL BEEF CATTLE SYNCHRONIZATION PROGRAMS

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Introduction

There are now a variety of products and systems available for estrous synchronization in beef cattle. However, usage of synchronization systems and AI are not employed by the vast majority of beef producers (Wallace, Select Sires, personal communication). Furthermore, of those who do synchronize, there are more failures than success stories. With beef cattle, all decisions, economic evaluations, and successes should be evaluated at the herd level, not at the subgroup or individual level. On a herd basis, most synchrony programs result in insufficient estrous and/or ovulation responses and low pregnancy rates for the dollars and time invested.

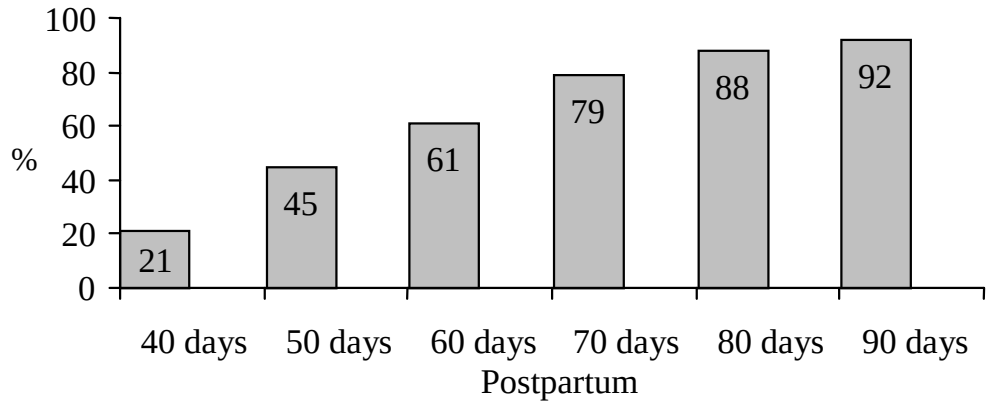
Why? Most producers are still searching for the "silver bullet" or "magic elixir" or "miracle product" rather than applying basic principles of beef herd management. Synchronizing beef cattle actually exacerbates poor management rather than yielding improved results. Beef producers cannot successfully adopt new technology before management fundamentals are in place. If we are to have success, veterinarians are going to have to become more involved with beef cattle management and sooner than when cows are in the chute for this year's drug of choice.

We will review key management factors critical for successful reproductive rates in beef herds. All of these must be attended to before estrous synchronization will yield satisfactory results. These controllable management factors are: 1) postpartum interval to start of breeding; 2) calving season duration; 3) a herd health program; 4) nutrition/body condition (mature cows, first-calf-cows and replacement heifers); and 5) weight gain at and during breeding.

Postpartum Interval

Published literature abounds where postpartum interval to first estrus has been reported. Data from Whitman (1975) will suffice as a typical example of when cows calving with a body condition scores (BCS) of 4-6 return to estrus (Figure 1). Not many beef cows return to estrus before 50 days postpartum. In fact, it will be 80 to 90 days postpartum before a majority of these cows have reinitiated estrous cycles.

Most recommendations (including those we have made) suggest not enrolling cows in the synchrony program that are not at least 40-45 days postpartum. Since most of these programs require a 7 to 10-day treatment duration, these cows would be at least 50 to 55 days postpartum at withdrawal of treatment when they are scheduled to exhibit a synchronized estrus.



Calving BCS 4-6; Whitman (1975)

Figure 1. Postpartum interval to first estrus in mature beef cows calving with body condition scores of 4 thru 6.

With a finite, fixed breeding season starting on or about the same date each year, there would then be cows treated which were between 45 days postpartum and 85 days postpartum. This is simple mathematics. If we begin breeding the same date each year and assume a 280-day average gestation, then breeding the subsequent year will begin approximately 85 days after the first cow has calved.

Calving Season

Cows will fall into a fairly predictable calving pattern, with some herd variation from year to year, based on length of the calving season (Figure 2). While this is only to be considered an example, it is surprising how accurate this depicts reality.

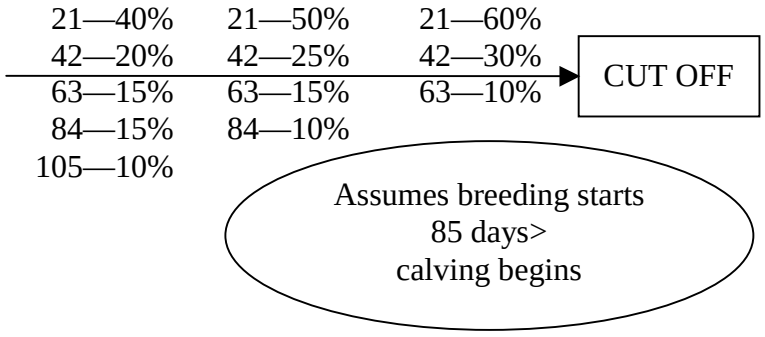


Figure 2. Typical dispersions of calving with 105, 84 and 63-day calving seasons.

If we only initiate an estrus synchronization program on those cows 42 days postpartum or greater and the herd is on a 105-day long calving season, we will exclude 40% of the cows in the herd. Not many producers have taken the time to actually do the math and see the economic

impact this makes on the synchrony program at the herd level. Even with a 63-day calving season, it will take excellent management to have the calving pattern depicted so that 90% or more of cows in the herd can be enrolled in the program.

A Herd Health Program

While this is a pretty dangerous place to be critical of health program in beef herds, especially those supposedly designed by veterinarians, it still needs to be said. We constantly hear of situations in the southeast where synchronization programs fail or are at least sub-optimum because of a disease situation. Herd level protection against most reproductive diseases takes a lot of scientific thought and management effort.

We have quit assuming veterinarians agree on or design efficient herd health programs. We have herds that are not vaccinated and are not protected. Even worse, we also have a lot of herds that are over vaccinated and under protected. This may be the cheapest part of the entire program and a well thought out herd level vaccination program using the latest principles of immunology and epidemiology must be in place. We will leave you to argue over what that program looks like.

Nutrition/Body Condition

Most are now well aware of the 9-point body condition scoring system used to evaluate body energy reserves in beef cattle (Table 1, Richards et al., 1986). We will spend some time trying to convince you that BCS at calving absolutely determines return to postpartum estrus. And, BCS at calving and plane of nutrition during breeding determines pregnancy rate. Body condition scores obtained at other times (particularly at weaning and 60-90 days prepartum) are key leverage points for management control.

There is some diagnostic value in analyzing pregnancy rates based on BCS obtained at weaning (Rae et al., 1993) since under most management situations we can generally assume cows have lost at least 1 unit BCS by the time calves are weaned. However, it is a retrospective analysis and does not help to get more cows pregnant unless changes are initiated.

Body condition score is our best measure of carcass energy or fat (Table 2, Wagner et al., 1988). For the purists among us, BCS can be converted to percent fat (as a percent of total body weight) or estimated fat cover (Table 3; Herd and Sprott, 1986). Note that cows with BCS of 5 are at about 16% fat with about .20 inch of fat over the 12 rib.

Mature Cows. Shorter intervals to first postpartum estrus and increased pregnancy rates are both observed when cows calve with increasing BCS (Whitman, 1975). In this study, BCS were grouped as Thin = BCS of 2 and 3, Moderate = BCS of 4, 5 and 6 or Good = BCS of 7 and 8. Percent pregnant in the first 20 days of breeding were 35 and 39% for moderate and good cows, respectively, compared to 25% for thin cows ($P < .05$); and at the end of an 80-day breeding season, were 89 and 92% for moderate and good cows, respectively, compared to 72% for thin cows ($P < .05$). Pregnancy rates for moderate and good cows were not statistically different.

Table 1. System of body condition scoring (BCS) for beef cattle.

Group	BCS	Description
Thin Condition	1	EMACIATED – Cow Is extremely emaciated with non-palpable fat detectable over spinous processes, transverse processes, hipbones or ribs. Tail-head and ribs project quite prominently.
	2	POOR – Cow still appears somewhat emaciated but tail-head and ribs are less prominent. Individual spinous processes are still rather sharp to the touch but some tissue over exists along the spine.
	3	THIN – Ribs are still individually identifiable but not quite as sharp to the touch. There is obvious palpable fat along spine and over tail-head with some tissue cover over dorsal portion of ribs
Borderline Condition	4	BORDERLINE – Individual ribs are no longer visually obvious. The spinous processes can be identified individually on palpation but feel rounded rather than sharp. Some fat cover over ribs, transverse processes and hipbones.
Optimum Moderate Condition	5	MODERATE – Cow has generally good overall appearance. Upon palpation, fat cover over ribs feel spongy and areas on either side of tail-head now have palpable fat cover.
	6	HIGH MODERATE – Firm pressure now needs to be applied to feel spinous processes. A high degree of fat is palpable over ribs and around tail-head.
	7	GOOD – Cow appears fleshy and obviously carries considerable fat. Very spongy fat cover over ribs and around tail-head. In fact “rounds” or “pones” beginning to be obvious. Some fat around vulva and in crotch.
Fat Condition	8	FAT – Cow very fleshy and over-conditioned. Spinous processes almost impossible to palpate. Cow has large fat deposits over ribs, around tail-head and below vulva. “Rounds” or “pones” are obvious.
	9	EXTREMELY FAT – Cow obviously extremely wasty and patchy and looks blocky. Tail-head and hips buried in fatty tissue and “rounds” or “pones” of fat are protruding. Bone structure no longer visible and barely palpable. Animal’s motility may even be impaired by large fatty deposits.

Richards et al. (1986)

Table 2. Correlation coefficients of body condition score with various estimates of carcass composition.

Total Carcass Energy	.92
Total Carcass Energy/HCW	.90
Total Carcass Energy/Live WT	.91
Total Fat	.91
% Fat	.91
% Protein	.07

Wagner et al. (1988)

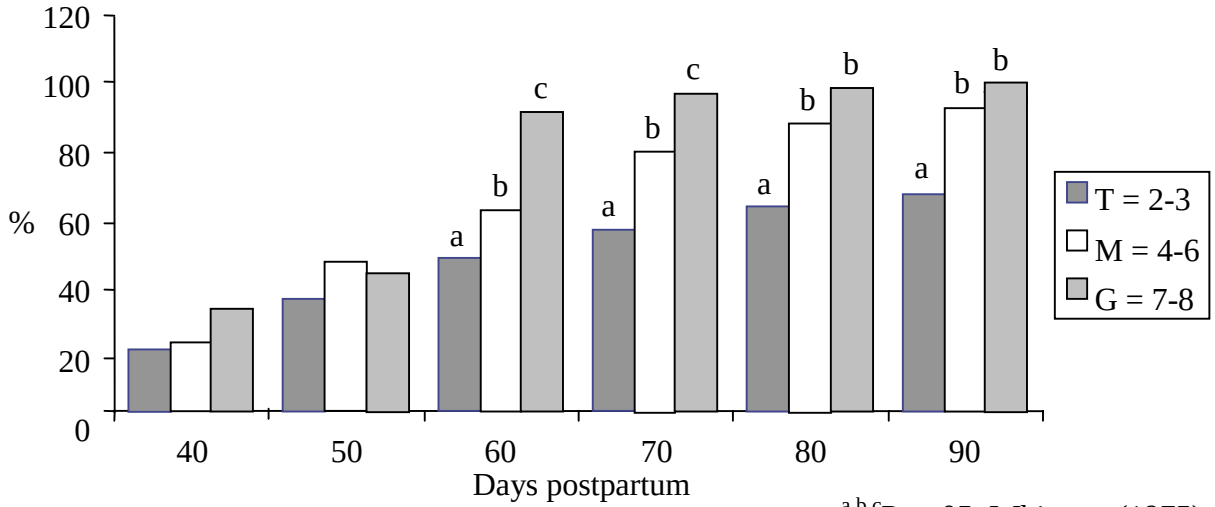
Table 3. Estimates of percent fat and fat cover based on BCS.

BCS	% Fat	Fat Cover
1	0	0
2	4	0
3	8	.05
4	12	.11
5	16	.19
6	20	.29
7	24	.41
8	28	.54
9	32	.68

Herd and Sprott (1986)

All of these cows were on the same nutritional plane and gaining weight from parturition thru the breeding season so these pregnancy rates were direct reflections of estrous response (Figure 3; Whitman, 1975). However, it was 60 days postpartum before significant differences were observed in estrous response. By 80 days postpartum estrous response for thin cows was 62%, which was less ($P < .05$) then the estrous response for moderate and good cows of 88 and 98%, respectively ($P > .10$).

We conducted a follow-up study (Richards et al., 1986) where we used a series of orthogonal contrasts to determine where significant differences occurred among BCS (Table 4). There were four nutritional regimes in this study, which produced ADG from parturition through the end of breeding of .30 kg (gain), .07 kg (maintenance), -.56 kg (loss) and -.43 kg (loss till 14 days prior to breeding and gain through the end of breeding). Cows calving in BCS $\geq$ 5 were in estrous at a higher rate earlier in the subsequent breeding season than cows calving in BCS $\leq$ 4 ($P < .05$). Furthermore, ADG from parturition through breeding had no effect on cows calving in BCS $\geq$ 5, but dramatic effects on cows calving in BCS $\leq$ 4.



[a,b,c]P < .05; Whitman (1975)

Figure 3. Body condition score at calving and estrous response in multiparous cows.

Table 4. Postpartum nutrition/body condition score 2 thru 8 at parturition and estrous response in multiparous cows.

		Cumulative % Estrus During Breeding			
	ADG (kg)	20-D		40-D	
PP NUTR	Parturition Breeding	BCS ≤ 4	BCS ≥ 5	BCS ≤ 4	BCS ≥ 5
G	.30	84[a]	82	97[c]	94
M	.07	83[a]	93	94[c]	97
L	-.56	67[b]	89	79[d]	98
L-G	-.43	71[b]	92	86[c]	96

[a,b]P<.06; [c,d]P<.01; Richards et al. (1986)

Over all 4 nutritional regimes, pregnancy rates at 20, 40 and 60 days of the breeding season for cows calving in BCS ≤ 4 were 41, 67 and 84%, respectively while for cows calving in BCS ≥ 5 pregnancy rates were 52, 79 and 91%, respectively (P < .05). Cows calving in BCS ≥ 5 also were pregnant an average of 6 days sooner than cows calving in BCS ≤ 4 (P < .05). There were also more cows in estrus early (76 versus 89%, P < .05, after 20 days of breeding; and 89 versus 96%, P < .05 after 40 days of breeding) with an average interval to estrus 12 days earlier (P < .05) for cows calving in BCS ≤ 4 or ≥ 5, respectively (Table 4).

A final issue with BCS in multiparous cows is that it does not appear to matter how cows achieve a BCS = 5 by parturition. A study was conducted where diet was manipulated to create cows in an array of BCS from 2 through 8 at 90 days prior to calving (Morrison et al., 1999). These cows were then assigned to one of three groups based on BCS where thin cows were BCS 2, 3 and 4 (AVE = 3.6), moderate cows were BCS 5 and 6 (AVE = 5.5) and good cows were BCS 7 and 8 (AVE = 7.1). These groups were then fed during the last trimester of pregnancy so all cows would calve with a BCS of 5 (AVE = 5.1). Prepartum BCS changes were 1.4, -0.4 and

–2.0 units for cows initially in thin, moderate or good groups, respectively (P < .01). Even with these dramatic prepartum changes in ADG and BCS, there were no differences in pregnancy rate among groups when all calved with BCS $\geq$ 5.

First-Calf-Cows. Primparous two-year-old cows can have reproductive rates comparable to multiparous cows but will require calving in a higher BCS. Pregnancy rates for primparous cows calving with BCS of 4 and 5 were 65 and 71% respectively, while pregnancy rates for primiparous cows calving with BCS of 6 and 7 were 87 and 91% respectively (P < .05, DeRouen et al., 1994). Intervals from parturition to pregnancy were 92, 82, 74 and 76 days for primiparous cows calving with BCS 4, 5, 6 and 7, respectively (4 vs. 5 vs. 6 and 7, P< .05).

We have reported an intense multi-state study in primiparous two-year-old beef cows (Spitzer et al., 1995) where we calved heifers in BCS 4, 5 or 6. Pregnancy rates improved with each improvement in BCS at parturition (Figure 4). Final pregnancy rates for a 60-day breeding season were 56, 80 and 96% for primiparous cows calving with BCS 4, 5 and 6, respectively (4 vs. 5 and 6, P < 05; 5 vs. 6, P < .10). These increased pregnancy rates due to increasing BCS were achieved with no increases in dystocia even though there were increases in birth weight of 3 to 4 pounds per increase in BCS (Table 5).

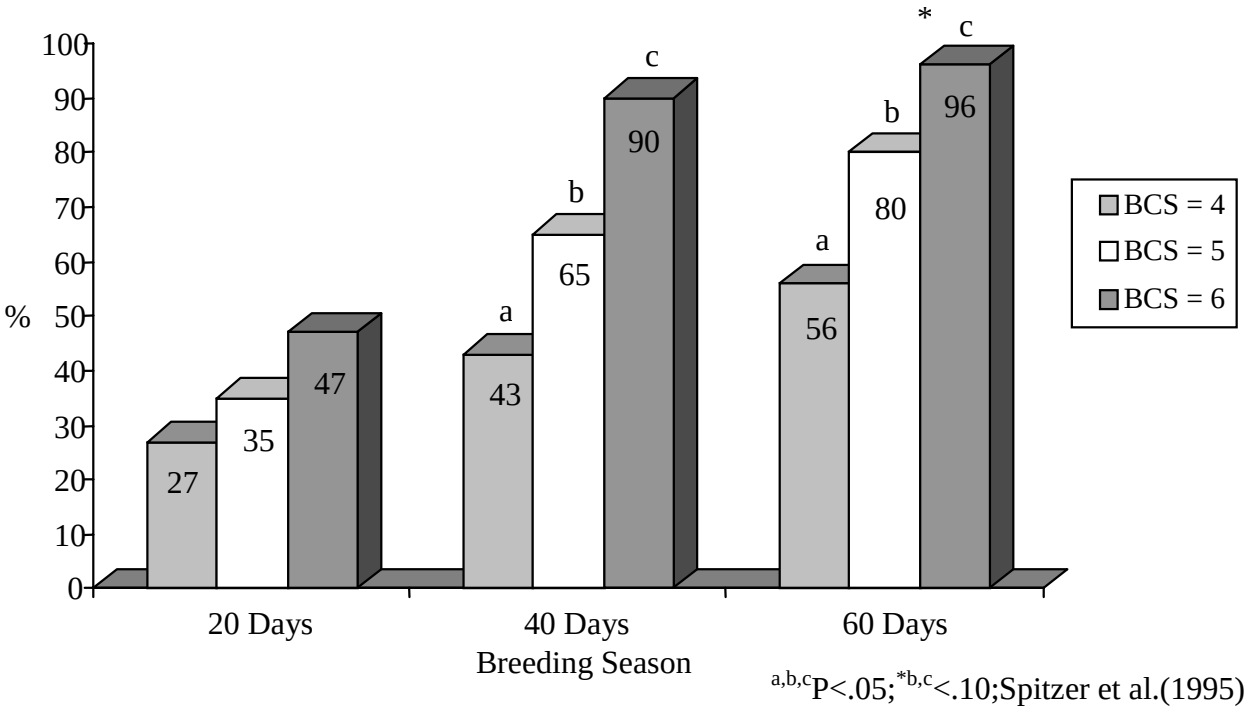


Figure 4. Body condition score at calving and pregnancy rate in first calf cows.

Table 5. Production parameters in first-calf cows.

BCS	WT	BW	DS	205-WW
4	745[a]	63.7[a]	1.2	412
5	826[b]	67.0[b]	1.2	425
6	935[c]	71.4[c]	1.2	437

[a,b,c]P<.05; Spitzer et al. (1995)

Heifers (Puberty). A general rule of thumb for virgin yearling heifers is to have them weigh 65% of their mature weight prior to start of breeding. Actually, this concept can be refined based on the frame score of the heifer (Table 6, Fox et al., 1988). Frame score 2 heifers do indeed need to achieve 65% of their mature weight to have a high rate of cyclicity while 60% of mature weight would be appropriate for frame score 7 and 8 heifers.

Table 6. Target weight concept: estimates of weight at puberty by frame score.

	205-D	Breeding		Maturity		
FM	HT	HT	TWT	HT	WT	%
2	37	43	618	46	950	65%
3	39	45	650	48	1025	63%
4	41	47	690	50	1100	63%
5	43	49	730	52	1175	62%
6	45	51	765	54	1250	61%
7	47	53	800	56	1325	60%
8	49	55	840	58	1400	60%

Fox et al. 1988 (Modified)

Economical management at least begs an awareness of these target weights and whether or not feeding systems can be designed to achieve these weights with some cost management. In some cases, feeding less resulting in a lower body weight and lower rates of cyclicity and retaining more heifers would have an economic advantage. Virgin yearling beef heifers achieving target weights represented in Table 6 would be in a BCS of 5 or 6.

While it is beyond the scope of this presentation, we have enclosed a concept of keys to successful management of virgin yearling beef heifers (Table 7). These management keys will get more yearling heifers pregnant. Concurrently, the number calving early will have a compounding effect on having more females calving prior to day 42 of the subsequent calving season and thus available for an estrous synchronization program.

Table 7. Keys to successful heifer management to first breeding.

1.	GENETICS (very critical in some breeds)
2.	RETAIN 15-25% more heifers @ weaning
3.	Start Breeding Season 14 days before cows
4.	Calculate Target Weights and Necessary ADG
5.	Monitor Weights
6.	Cull Heifers Again at Yearling Weight
7.	Breed for 30 to 45 days
8.	Sire Selection to Reduce Dystocia

Weight Gain at Breeding

Does weight gain or loss during the breeding season influence pregnancy (conception) rates? We believe so, you believe so (we think), but we do not have definitive data to be certain. Absolutely, we have data indicating rates of gain during breeding does effect pregnancy rates in cows calving in BCS $\leq$ 4 (or $\leq$ 5 for primiparous cows). But, is this a reflection of weight gain on conception rates or increasing BCS and therefore increasing estrous response?

Certainly, there is anecdotal evidence to suggest that after estrous cyclicity is established (virgin heifers) or reestablished (postpartum cows) then cows "breed better" if gaining weight. However, we find no empirical evidence to support that hypothesis. Experiences though tell us we don't want females losing weight during the breeding season.

Review and Conclusions

In summary, we can make these assertions about BCS: 1) BCS = % Fat, 2) BCS is a reliable predictor of return to estrus, 3) threshold BCS for multiparous cows = 5, 4) threshold BCS for primiparous cows = 6, 5) virgin yearling heifers at target weights indicated in Table 5 will be BCS = 5 or 6, 6) if cows are gaining weight ever so slightly postpartum, BCS is a very reliable predictor of pregnancy.

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