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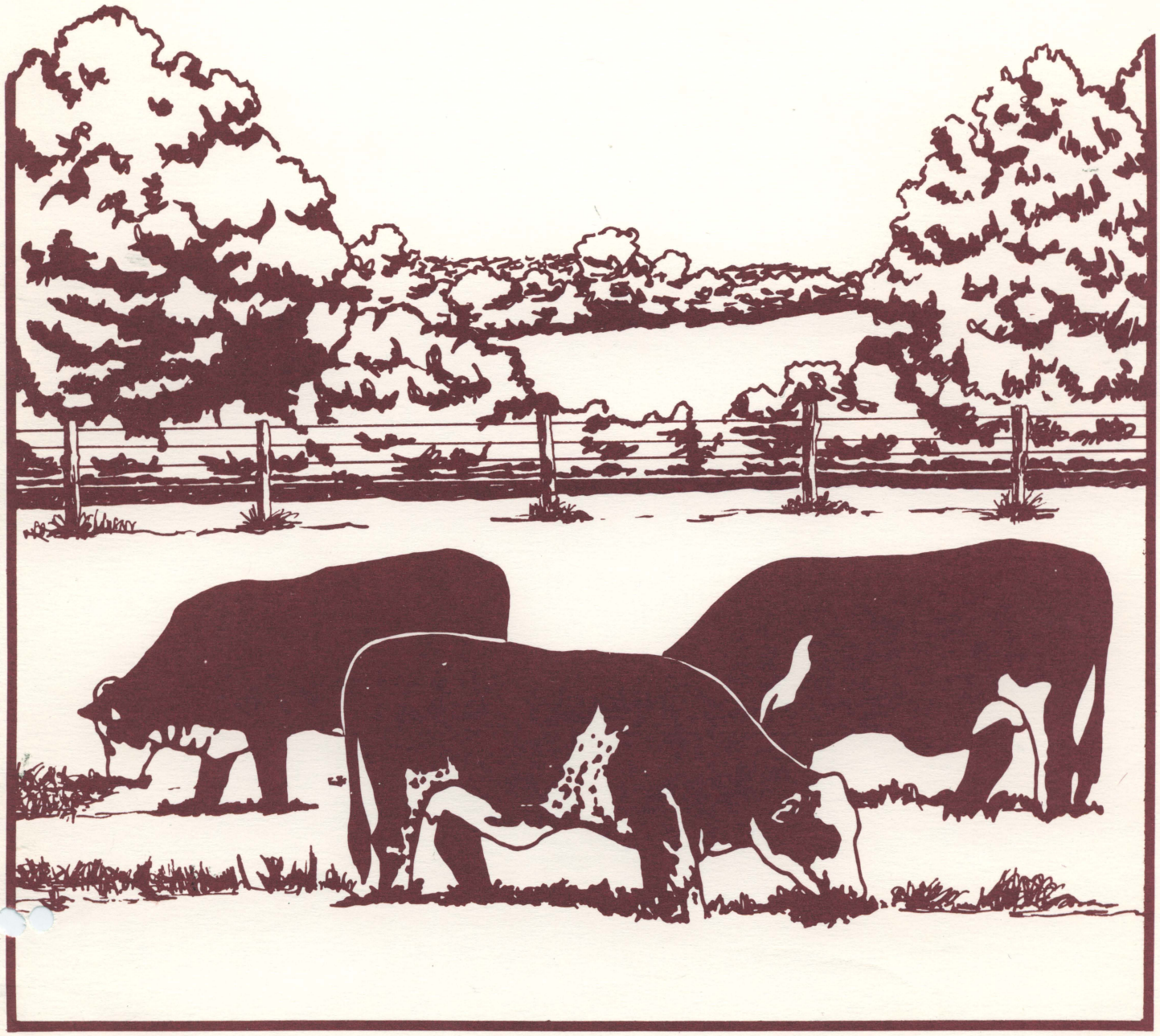

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Management of Replacement Heifers for a High Reproductive and Calving Rate

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Profitable beef production requires producing maximum pounds of beef at the least possible cost. This profitability is primarily dependent on reproductive performance, best measured by percent calf crop. "Percent calf crop" is the number of calves weaned, divided by the number of cows in the breeding herd at the start of the breeding season.

Tremendous variation exists in percent calf crop in Texas, with some herds having 30 to 50 percent calf crops and others 90 percent or greater calf crops. Obviously, the closer the calf crop is to 100 percent, the more calves there are to market and recover costs charged against the total cow herd.

Because calves are weaned at a given time in many beef operations, cows calving late in the calving season wean fewer pounds of calf than do cows calving early. Early calving cows wean more pounds of calf because their calves are older at weaning and have a higher rate of gain from birth to weaning (1, 2).

Table 1 summarizes a study in which 8,742 calves were divided into three groups based on weaning weight. Calves in the high group weighed 116 pounds more than calves in the low group, and 57 pounds more than calves in the medium group. Calves in the high group gained .40 pounds more per day than calves in the low group; .19 pounds more than the medium group. Notice that 70 percent of these heavier, faster gaining calves were born in the first 20 days of the calving season.

In addition to weaning heavier calves, cows calving early in the calving season have better rebreeding rates. More cows calving late in the calving season are open at the end of the following breeding season (4, 5, 6).

Replacement Heifer Management Plan

Successful ranching operations are seldom the result of guesswork, but evolve from planning. The following is an outline of a heifer development system that has proven successful and economical on

Table 1. The relationship between actual weaning weight of calves and their time of birth during a 60-day period (3).

Weaning wt. rank	Number of calves	Weaning weight	Weaning age	Average Daily gain	High, medium and low weaning weight calves born during		
					First 20 days	Second 20 days	Third 20 days
High	2910	417	207	1.68	70%	24%	6%
Medium	2916	360	195	1.49	42%	39%	19%
Low	2916	301	181	1.28	19%	33%	48%

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many ranches. It will require some adaptation to different ranching situations, but it can be a sound, economical and profitable guide. Following this plan is a more complete discussion reinforcing these recommendations.

Heifer selection — weaning

- If possible, retain only heifers with heavy actual weaning weights.
- Retain more heifers than needed for replacements. (The number of additional heifers needed varies; however, consider retaining 50 to 100 percent more than needed to allow for selection.)
- Remove all heifers with abnormalities or structural defects.
- Avoid selection of heifers on visual characteristics of type or femininity.

Management — weaning until breeding

- Determine weight of heifers at weaning. Determine number of days from weaning to expected breeding. Determine desired weight at breeding, using Table 2 or on the basis of 65 percent of expected mature weight.
- Calculate necessary rate of gain from weaning to breeding and sort heifers into two or more groups as needed.
- Feed heifers to grow at the calculated level. Check development by periodic (monthly) weighing throughout the feeding period. Each heifer needs to be at the target weight by the start of the breeding season.

Management — at breeding

- Remove heifers showing noticeable unsoundness.
- Initiate heifer breeding 20 to 30 days before regular breeding season.
- Carefully select bulls to breed to heifers to eliminate calving problems.
- Breed for no more than 60 to 90 days and remove bulls.

Management — after breeding

- Pregnancy test 45 days after end of breeding period.
- Retain *only* heifers which became pregnant in the first 45 days of breeding for replacements.
- Market all non-pregnant and late breeding heifers to your best advantage.
- Separate pregnant heifers 60 to 90 days before calving and keep them separated for special care at calving and through the breeding season.
- Grow heifers at a rate of 1 to 1½ pounds per day — have them in moderate to good body condition at calving time.

Management — at calving

- Move early-bred heifers into easily accessible pasture area for observation.
- Continue to grow first-calf heifers. Have them gaining approximately ¼ pound per day from calving through breeding.

Management — second breeding season

- Consider early weaning of calves at 30 to 60 days of age or once-a-day nursing after calves are 20 to 30 days of age if first-calf heifers are in poor body condition or if you are short of feed.
- Breed for 60 to 90 days, starting with the regular cow herd, and pregnancy test 45 days after end of breeding period.
- Sell non-pregnant first-calf heifers.

Puberty in Virgin Heifers

Heifers cannot be bred early unless they reach puberty prior to, or early in, their first breeding season. One alternative is to calve heifers as 3-year-olds. However, production economics dictate that few cattlemen can afford the luxury of calving heifers at 3 years of age. Heifers bred to calve at 2 years produce more calves in a lifetime, with higher average weaning weights, than those bred to calve first at 3 years (7). In addition, high monthly maintenance costs make it necessary to get heifers into production as early as possible.

To calve at about 2 years of age, a heifer must reach puberty by 13 to 16 months of age. There is much variation in age at puberty among heifers. Breed, environment, nutrition and other factors must be considered (8, 9). Genetic selection definitely plays a role in determining the age and weight at puberty among and within breeds of cattle (10,11,12). Heritability estimates for age and weight at puberty are moderate to high. This means that selection for heifers reaching puberty between 13 and 16 months of age would eventually reduce the average age at puberty within a herd.

Most heifers show estrus between 13 and 16 months of age if they are of sufficient size and weight. Exceptions to this include Brahman heifers, Brahman crossbred heifers and heifers from some breeds derived from crosses with Brahman. Approximately 90 percent of Brahman crossbred heifers show estrus, provided sufficient weight is

Table 2. Estimates for heifers reaching puberty at various weights (9).

	Heifers Reaching Puberty		
	50% in heat	70% in heat	90% in heat
Angus	550	600	650
Brahman	675	725	750
Brangus	600	650	700
Charolais	700	750	775
Hereford	600	650	700
Santa Gertrudis	675	725	750
Shorthorn	500	550	600
Brahman x British	675	725	750
British x British	575	625	675
Charolais x British	675	725	775
Jersey x British	500	550	600
Limousin x British	650	700	775
Simmental x British	625	675	750
S Devon x British	600	650	725

attained, at 15 to 17 months, while purebred Brahman heifers may be close to 20 months of age before 90 percent reach puberty (8). Heritability estimates for age at puberty indicate that genetic selection would reduce the average age at puberty in Brahman cattle.

A summary of data available on weight necessary for 50, 70 or 90 percent of heifers reaching puberty appears in Table 2. For example, 50 percent of Angus x Hereford heifers, 13 to 16 months of age and weighing 575 pounds, could be expected to have reached puberty. This is the *average* weight at puberty. To expect 90 percent of these Angus x Hereford heifers to be in heat, each would need to weigh 675 pounds.

Information is presented for other breeds where there are enough data to make recommendations. If a particular breed or crossbreed is not represented on this chart, a rule of thumb is that each heifer should achieve 65 percent of her mature weight before the first breeding season.

Management and Feeding Groups

Consider for example, a producer who has 100 Angus x Hereford heifers with an average weaning weight of 472 pounds on September 1. These heifers will be on winter pasture until April 1, the start of the breeding season, and past performance on this ranch indicates the heifers gain 1 pound per day. These heifers would then weigh 683 pounds on April 1, an adequate weight to expect 90 percent or more to come into heat during the breeding season. *But,* 472 pounds was the *average* weight at weaning. The lightest heifer weighed 352 pounds and the heaviest heifer weighed 552 pounds at weaning. If all heifers gained 1 pound per day for 211 days, the lightest heifer would weigh 563 pounds and the heaviest heifer 763 pounds. Some of the heifers would be too light and others much heavier than necessary. Averages will not get the job done. For 90 percent of these Angus x Hereford heifers to be in heat during the breeding season, each individual should weigh 675 pounds.

Ideally, selecting only replacement heifers with heavy actual weaning weights would be the most beneficial to economical beef production. Heavy heifers would need to gain less weight from weaning to the start of breeding to reach target weights discussed above. Additionally, heavy actual weaning weights reflect a dam with good milk production who calved early in the calving season, both highly desirable traits that will be passed on to the heifer to some degree.

The ideal, however, is seldom realized because many variables influence heifer selection programs. Long, extended calving seasons, the need for a large number of replacement heifers and value as a registered animal are a few considerations that may cause retention of lightweight heifers. But, these heifers still must reach appro-

Table 3. Weight changes and feed costs for light and heavy heifers when fed separately or as a group (13).

	Fed together		Fed separately	
	Light heifers	Heavy heifers	Light heifers	Heavy heifers
Number of heifers	10	10	19	20
Weaning weight (lb.)	376	475	374	464
Daily gains (lb.)				
Projected	1.5	1.4	1.72	1.17
Actual	1.27	1.47	1.81	1.24
Breeding weight (lb.)				
Projected	715	715	715	715
Actual	620	719	669	722
Winter feed cost	33¢	33¢	39¢	29¢
	Combined 33¢		Combined 34¢	

Table 4. Reproductive performance for light and heavy heifers when fed separately or as a group (13).

	Fed together		Fed separately	
	Light heifers	Heavy heifers	Light heifers	Heavy heifers
Number of heifers	10	10	19	20
Age at puberty (days)	423	404	405	389
Cycling at start of breeding (percent)	60	90	79	90
Pregnant in 45-day breeding season (percent)	60	80	79	90
	Combined 70%		Combined 85%	

priate target weights to have satisfactory reproductive performance.

Recent work has shown an increase in reproductive performance when heifers were sorted into light and heavy groups and fed to reach target weights (13). Heifers fed separately were more similar in weight at the start of the breeding season than were heifers fed together, Table 3. As has been reported for mature cows, smaller heifers are less able to compete for available feed when fed with larger, more aggressive heifers (14).

Sorting heifers into feed groups resulted in a 19 percent increase for light heifers cycling at the start of the breeding season and an increase of 15 percent in total heifers pregnant after 45 days of breeding, Table 4. The cost for this extra 15 percent in pregnancy rate was 1¢ per day. Note, however, that light heifers at weaning required considerably higher investment to reach the target weight and still had poorer reproductive performance than heifers which were heavy at weaning.

Table 5 summarizes projections made for 100 Angus x Hereford heifers when fed together or sorted. If fed together, the projection is that 57 percent of the heifers would be pregnant after 20 days and 81 percent after 40 days of the breeding season. This assumes a 70 percent conception rate to a single breeding.

Sorting the heifers into three groups based on weight gain needed to reach a target weight would increase the proportion of heifers pregnant to 63 percent in 20 days and 90 percent in 40 days of breeding. More heifers are pregnant and more are pregnant early in the breeding season when the heifers are sorted.

Feed costs would be similar — the average daily gain is 1 pound per day for both groups. However, when heifers are sorted, feed dollars have been allocated where they will do the most good. Reproductive performance in the heifers fed as a group would probably be less than indicated in this example. The light heifers would not gain as much as the heavy heifers because of competition for available feed.

Weight at First Breeding — Rebreeding

Feeding virgin heifers to appropriate weights prior to first breeding also influences rebreeding after the first calf. Data presented in Table 6 indicate two problems with heifers being too light at

Table 5. Projections for reproductive performance when heifers are sorted or fed as a group.

Feeding group	Number of heifers	Weaning weight	Daily gain to breeding	Projected weight at breeding	Expected in heat (percent)		Expected pregnant (percent)	
					20 days	40 days	20 days	40 days
Fed together								
Heavy	50	503	1.0	713	100	100	70	92
Moderate	30	462	1.0	673	70	90	49	77
Light	20	411	1.0	622	50	70	35	60
Total	100	472	1.0	683	81	91	57	81
Fed separately								
Heavy	50	503	.85	682	90	100	63	90
Moderate	30	462	1.1	694	90	100	63	90
Light	20	411	1.3	685	90	100	63	90
Total	100	472	1.0	687	90	100	63	90

Table 6. The effects of weight at first breeding on reproductive performance in Hereford heifers (15).

	Weight at start of first breeding season		
	Less than 550 lb.	550-600 lb.	More than 600 lb.
Number of heifers	40	166	45
Pregnant in first year (60 days)	56%	77%	90%
Pregnant in second year (60 days)			
of heifers calving	18%	57%	69%
of original heifers	8%	40%	60%

first breeding. Not many get pregnant as virgin heifers and they have a greatly reduced chance of getting pregnant while nursing their first calf. Note that in the Hereford heifers, 90 percent of the heifers weighing more than 600 pounds at the start of breeding were pregnant. Only 56 percent of the heifers weighing less than 550 pounds were pregnant. In the subsequent breeding season, only 18 percent of those calving from this group were pregnant. Only 8 percent of the lightweight heifers exposed the first year did not skip a calf. A few heifers get pregnant at very light weights, but calving problems will be increased and their chances of being rebred while nursing their first calves are practically nonexistent.

Calving Difficulties and Death Loss

Studies have shown that 75 percent of calves lost prior to weaning are lost at or near birth. Of this number, 80 percent or more of the deaths result from dystocia or calving difficulties (16). Older cows are bigger, have larger pelvic openings and, consequently, have much less difficulty than do younger cows. Most calving problems occur in heifers calving for the first time.

Research indicates that, in herds where the first calf is dropped as a 2-year-old, 46 percent of these heifers experienced calving difficulties. Three-year-olds (second calf) experienced difficulties 22 percent of the time and cows 4 years old and older (third or more calf) account for about 3 percent of calving problems (17). In herds where the first calf is dropped as a 3-year-old, dystocia will be somewhere between 22 and 46 percent. While dystocia is decreased, it is not eliminated by calving first at 3 years of age.

While a heifer's weight is directly related to puberty and rebreeding after her first calf, weight and body size also are important factors in calving problems. Although some heifers come into a fertile heat at weights between 450 to 500 pounds, they may not have the ability to produce a calf. Reports on heifer weights just before calving have shown that heifers weighing 625 to 774 pounds experienced difficulty in 36 percent of the cases. At weights of 775 to 924 pounds, difficulty was experienced 15 percent of the time; at 925 pounds or heavier, only 9 percent had problems (18). Heifers must attain certain minimal size to avoid serious calving problems.

Table 7. Effect of level of energy fed prior to calving on calving difficulty (19).

Energy level	Calving difficulty (percent)	Calf birth weight (pounds)
High (8# TDN)	36	70
Low (4.3# TDN)	33	63

Increased body weights of heifers discussed should not be confused with fattening. The objective is to grow heifers to heavier weights at an earlier age. Studies on finish as related to calving problems have shown that extremely fat heifers (would have graded high choice or prime) had 18 percent dead calves at birth and 27 percent dying within the first 24 hours after calving. Heifers in moderate flesh (good to choice) experienced 9 percent dead calves at birth and thin heifers had 10 percent. No calves were lost within 24 hours of calving from either the moderate or thin heifers (19).

This research and data presented in Table 7 also help to dispel the belief that starving or limited feeding of heifers before calving is of real benefit. Calving losses are not reduced by feeding heifers lower levels of feed before calving. While birth weight was reduced 7 pounds by feeding the low level of energy before calving, calving difficulty was not reduced. It has been observed that heifers on low levels of feed prior to calving have a reduction in skeletal growth, including the pelvic area. The calf will be smaller, but so will the heifer and her pelvic area through which the calf must pass in the birth process.

Table 8. Effects of gestation feed level on dystocia and reproduction in heifers (20).

Sire breeds[a]	Gestation feed level[b]	Postcalving body weight (pounds)	Calf birth wt. (pounds)	Dystocia (percent)	Pregnancy rate (percent)
(Charolais, Hereford and Angus)	Low	694	68	61	65
	High	794	71	56	83
	Difference	100	3	5	18

[a]Results of three studies combined; 133 head of animals

[b]Low = 3.5 to 4 lb TDN; High = 6.9 to 7.5 lb TDN last 90 days gestation.

Reducing levels of feed to first-calf heifers only results in reduced growth and poorer rebreeding performance as noted in Table 8. To breed heifers as yearlings, get a live calf and get the heifer rebred, they need to be well-fed.

Bull Selection

Calving problems can be reduced by breeding heifers to bulls that sire small calves and, consequently, cause little difficulty at birth. While certain bulls may be eliminated, the only successful means of selection is based upon past performance, rather than appearance. This does not mean any particular breed, nor is it necessarily related to the size of the bull. The decision is determined by the type of calves produced by the bull. Obvious, but sometimes overlooked, is the fact that young bulls, while themselves smaller in body size, do not necessarily sire smaller calves. A small young bull sires the same size calf that he will sire at full size and maturity.

Recent studies indicate that breed of sire has a large influence on calving difficulty. Data shown in Table 9 emphasize the effects of sire, age of dam and birth weight on calving problems. Technical analysis of the data reveals no statistically significant difference in birth weight or calving difficulty between the larger breeds (Charolais, Simmental, Limousin and South Devon). In the smaller breed category, there was no difference between Jersey and Angus, but there were more calving difficulties for Hereford sires.

Such data make it apparent that virgin, and even 3-year-old, first-calf heifers cannot be bred to the larger breeds and be expected to hold calving problems to a reasonable level. When larger breeds are bred to young heifers, special steps for their care must be initiated and even then the prognosis is poor.

Data such as those shown in Table 9 represent average breed performance. Individual bulls in the small breed group can cause as many or more problems than the average of the larger group. Also, some bulls of the larger type cause fewer problems than the breed average. Such bulls (larger breed-minimum calving problems) nearly always have a record of a light birth weight, as do many of their ancestors.

Rebreeding Problems

To increase weaning weights through more early-born calves, cows and heifers have to breed back early following calving. Cattlemen have noted for some years that heifers calving for the

Table 9. Calving difficulty as related to age of dam, birth weight and sire (21).

	Cow Age in Years (Angus and Hereford Dams)					
	2		3		4 & 5	
Breed of sire	Calving difficulty (percent)	Birth weight (pounds)	Calving difficulty (percent)	Birth weight (pounds)	Calving difficulty (percent)	Birth weight (pounds)
Hereford	38	67	7	71	2	74
Angus	27	63	3	68	0	73
Jersey	12	59	6	66	2	63
South Devon	63	72	29	79	6	78
Limousin	74	73	10	79	9	84
Simmental	66	76	22	83	10	85
Charolais	68	75	19	80	6	85
Average	50	70	14	75	5	77

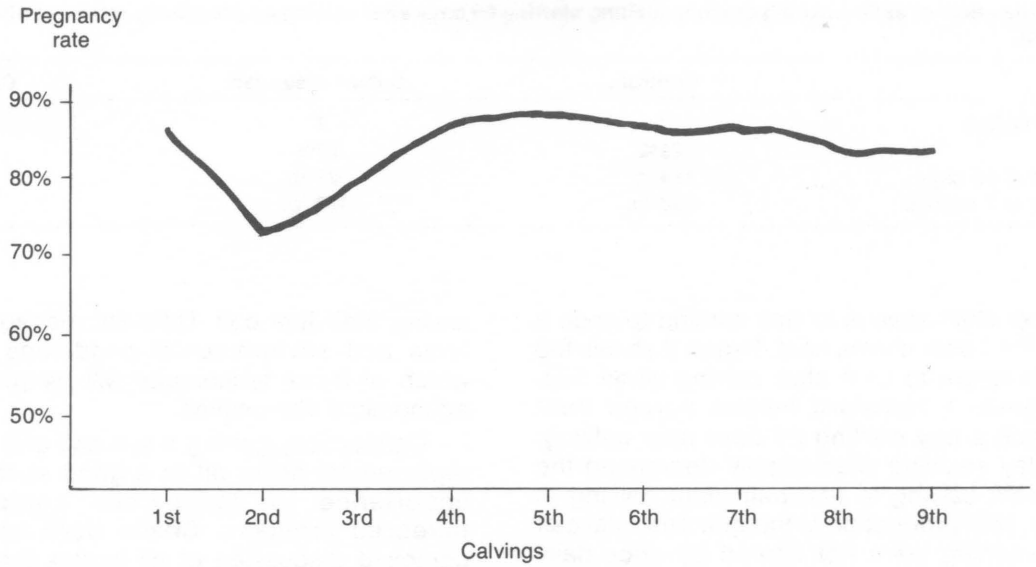

Figure 1. Effect of calving on percent calf crop in beef cattle (22).

first time tend to have lower pregnancy rates and breed back later in the breeding season following their first calf, even in well-managed herds. Figure 1 shows this drop in pregnancy rate.

Many first-calf heifers take longer to return to heat following calving than do mature cows and fail to rebreed or breed late during their second breeding season. Table 10 shows the delay in return to heat after calving in first-calf heifers. This delay is caused by the greater stress that calving places on the first-calf heifer. Heifers perform all of the body functions of mature cows — body maintenance, calving, lactation and rebreeding. In addition, body growth is still occurring. The heifer has a limited capacity for feed because of smaller size and because incisor teeth are being shed at this time. Consequently, the heifer's ability to consume feed, particularly low-quality roughages, is limited. Thus, some body functions are sacrificed and reproductive capability suffers first. Additional stress is added if calving difficulty occurs.

Increase Rebreeding Rates

Three management practices have been demonstrated to successfully overcome problems in rebreeding first-calf heifers. One management practice is to breed virgin heifers 20 to 30 days earlier than the rest of the cow herd to assure early calves. Calving early gives heifers extra time to return to heat during the second breeding season, which would then correspond to that of the regular cow herd.

A second management practice is to separate heifers from mature cows and provide higher quality feeds during the last 2 to 3 months of pregnancy and through the breeding season. This decreases competition from mature cows for available feed.

A third management practice, used less often but gaining in popularity, is to eliminate or alter the suckling pattern. Weaning calves at 30 to 90 days of age removes the primary stress on heifers and makes more nutrients available for other body functions such as growth and rebreeding.

Table 11 shows the effects of early weaning of calves on the reproductive performance of their dams and subsequent calf performance to weaning. Complete removal of lactational stress showed a marked increase in rebreeding efficiency. Even removing only a portion of the suckling stress by creep feeding aided in improving pregnancy rates.

Examples in Texas have shown pregnancy rates of more than 90 percent from first-calf heifers when calves were weaned at 30 to 90 days of age. This can be done without sacrificing calf weaning weight, Table 11. However, the cost of feeding the early weaned calf from 60 days of age to 7 months often is too high to be economical except under extreme drouth or other severe conditions.

Table 10. Percent of cows showing heat at various times after calving (23).

	Days after calving					
Group	**40**	**50**	**60**	**70**	**80**	**90**
Mature cows	30	53	72	82	89	94
First-calf heifers	15	24	47	62	68	79

Table 11. The effect of early weaning or creep feeding starting 60 days after calving on pregnancy rates in a 90-day breeding season (24).

	Control	Calves creep-fed	Calves weaned
Number of heifers	7	7	7
Pregnant	29%	57%	100%
Calf weight @ 60 days	114 lb.	99 lb.	134 lb.
Calf weight @ 7 months	352 lb.	378 lb.	376 lb.

Another alternative is to limit nursing to once a day until the heifer shows heat. Figure 2 shows the effects on return to heat after calving when first-calf Brahman x Hereford heifers nursed their calves once a day starting 21 days after calving. Once-a-day suckling dramatically decreased the interval from calving to first heat after calving in this study. Milk production of the cow and total calf gain to weaning were not altered by once-daily suckling, and no difference was noted in health problems.

Breeding virgin heifers earlier than the regular cow herd, separating heifers from mature cows, early weaning and once-a-day nursing of calves are effective management methods to improve reproductive performance in heifers being bred following their first calf. Different management systems and environmental conditions determine which of these techniques will be practical and economical alternatives.

Conception, getting a live calf and getting the replacement heifer off to a good start are of top importance to commercial cattlemen and purebred breeders. Space does not permit a complete discussion of all factors that might reduce calving percentages in young heifers, nor can today's technology explain all the problems related to fertility. However, enough answers are available to reduce infertility problems by more than one-half and to increase dramatically the percent calf crop.

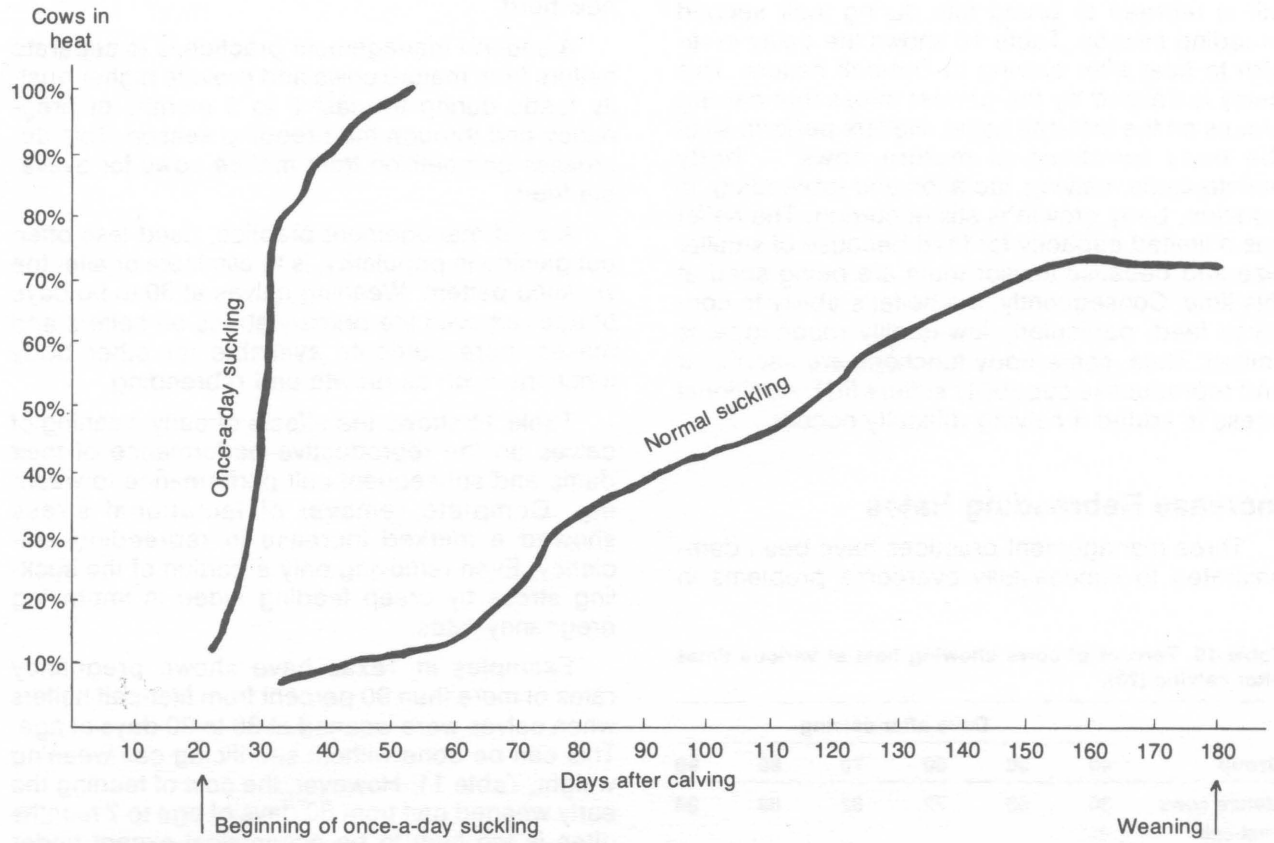

Figure 2. The effect of once-a-day suckling on return to heat in first calf Brahman x Hereford heifers (25).

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