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Management of Replacement Heifers for a High Reproductive and Calving Rate

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A profitable beef operation involves producing the maximum pounds of beef at the least possible cost. Profitability is primarily dependent on reproductive performance, which is 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.

This statistic varies widely in Texas, with some herds having 30 to 50 percent calf crops and others 90 percent or greater. Obviously, the closer the calf crop is to 100 percent, the more calves there are to market and the better the recovery of direct costs associated with the cow herd.

In many beef operations calves are weaned at a given time; therefore, cows calving late in the calving season wean smaller calves than do cows calving earlier. Early calving cows wean heavier calves 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 weight group weighed 116 pounds more than the calves in the low weight group, and 57pounds more than calves in the medium weight group. Calves in the high group gained .40 pounds more per day than calves in the low group and 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 than cows calving late in the calving season (4, 5, 6). The herd should be managed to increase the proportion of early calving cows. Such things as disease control, adequate nutrition, annual culling of open and late calving cows, and proper heifer management are essential elements of management for earliness of calving. Good heifer management maybe the most critical management tool. It produces a uniform group of heifers that, when given an opportunity to conceive early in the first breeding season, will calve early in the first calving season. These heifers usually remain early calvers throughout their productive life and wean the heaviest calves.

Replacement Heifer Management Plan

Successful ranching is seldom the result of guesswork, but evolves from planning. The following heifer development system has proven successful and economical on many ranches. It can be adapted to different ranching situations and is a sound, profitable guide. A more complete discussion of these recommendations follows.

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

Weaning weight rank	Number of calves	Weaning weight	Weaning age	Avg. 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%

Heifer selection at weaning:

- Retain only heifers with heavy actual weaning weights. These are the easiest and cheapest heifers to feed to their respective 15-month-old target weights (Table 2).
- Retain 10 to 15 percent more heifers than the replacement rate requires. This added margin is needed to account for the small proportion of replacements that fail to conceive. Saving too many heifers (in excess of 20 percent of actual needs) may reduce gross margin returns to the operation.
- Do not retain heifers with structural defects.
- Do not select heifers based only on visual character and femininity. These factors are not as important as parental performance history.

Management from weaning until breeding:

- Weigh all heifers at weaning (7 to 9 months of age). Determine the number of days from the day of weaning to the start of the breeding season (14 to 16 months of age). Determine the desired target weight by the start of breeding using Table 2. If your breed is not listed in Table 2, the heifers should weigh 65 percent of the expected mature weight.

Calculate necessary daily weight gain per heifer from weaning to start of breeding.

Example 1:

- weaning weight = 550 pounds

- target weight = 700 pounds

- days from weaning to start of first breeding = 274 days (15 months - 6 months) X 30 days/month + 4 days (to account for months with more than 30 days)

- daily weight gain needed = 0.55 pounds

$$\frac{(700-500)}{274 \text{ days}} = 0.55 \text{ pounds}$$

Example 2:

- weaning weight = 425 pounds

- target weight = 700 pounds

- days from weaning to start of first breeding = 274 days

- daily weight gain needed = 1.00 pound

$$\frac{(700-425)}{274} = 1.00 \text{ pound}$$

In the two examples, the difference in average daily gain needed suggests that the retained replacement heifers may need to be sorted at weaning into light and heavy groups to achieve desired gain (see Table 3). This is especially true when there is a wide difference between the lightest and heaviest heifers.

Table 2. Estimates for heifers reaching puberty at various weights (10).

	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

Table 3. Weight changes and feed costs for light and heavy heifers when fed separately or as a group (15).

	Fed together		Fed separately	
	Light heifers	Heavy heifers	Light heifers	Heavy heifers
Number of heifers	10	10	19	20
Weaning Wt.(lbs.)	376	475	374	464
Daily gains (lbs.)				
Projected	1.5	1.4	1.72	1.17
Actual	1.27	1.47	1.81	1.24
Breeding Wt.(lbs.)				
Projected	715	715	715	715
Actual	620	719	669	722
Winter feed cost per head per day	$0.75	$0.75	$0.89	$0.67
	Combined $0.75		Combined $0.78	

- Design rations to achieve desired daily gain. Monitor gain by weighing the heifers each month during the feeding period. Adjust rations if actual weight gains vary too much from the planned weight gains.

Management at breeding:

- Remove heifers showing noticeable unsoundness resulting from lameness or chronic illness.
- Initiate breeding 20 to 30 days before the start of the breeding season in the mature cow herd.
- Mate heifers to bulls with a history of calving ease.
- Breed for no more than 70 days and then remove bulls from the herd.

Management after breeding:

- Pregnancy test 60 to 65 days after the end of breeding. This allows for early detection of open, non-productive heifers.
- Retain those heifers that conceived.
- Market all open heifers to your best advantage. Subsequent fertility in these heifers often is not acceptable, and they should not be retained for next year's breeding.
- Beginning 60 to 90 days before the start of calving, separate pregnant heifers from the mature cow herd to facilitate adequate feeding and special care during calving.
- Feed heifers (or allow adequate grazing) to weigh at least 85 to 90 percent of their expected mature weight by the start of first calving.
- By the start of calving, heifers need a body condition (fat stores) score of at least 5 or 6 or else rebreeding rates will be low.

Management at calving:

- Hold heifers in an easily accessible pasture for observation and assistance during calving.
- Check heifers three or four times a day and be 'ready to help those that may experience dystocia (difficult delivery).
- Continue to feed heifers to maintain their body condition through calving and rebreeding. Excessive weight loss will lower body condition and will reduce rebreeding percentage (7).

Management during the second breeding season:

- If first calf heifers are in poor body condition and/or you are short of feed, consider early weaning of their calves by 30 to 60 days of age; or use once-a-day suckling by the time calves are 30 days old.
- Breed for 60 to 80 days, starting the breeding season at the same time as the mature cows, and pregnancy test 60 days after the end of breeding.
- Cull all first-calf heifers that fail to re-breed.

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, but few cattlemen can afford this luxury. 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 (8). In addition, high monthly maintenance costs make it necessary to get heifers into production as early as possible.

To calve at 2 years of age, a heifer must reach puberty by 13 to 16 months of age. Breed, environment, nutrition and other factors must be considered (9, 10). Genetic selection definitely plays a role in determining the age and weight at puberty among and within breeds of cattle (11, 12, 13). 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 reach puberty between 13 and 16 months of age if they are of sufficient size. Exceptions to this include Brahman heifers, Brahman crossbred heifers and heifers of some of the later maturing European breeds. Approximately 90 percent of Brahman crossbred heifers reach puberty at 15 to 17 months, provided sufficient weight is attained, while purebred Brahman heifers may be closer to 20 months of age before 90 percent reach puberty (9). Heritability estimates for age at puberty Indicate that genetic selection would reduce the average age at puberty in Brahman cattle and other later maturing breeds.

A summary of data available on the weight necessary for 50, 70 or 90 percent of heifers to reach 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. For 90 percent of the Angus x Hereford heifers to experience puberty, the average weight at puberty would have to be 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 by 14 to 15 months of age.

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. Past performance on this ranch indicates that 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 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 estrus (heat) during the breeding season, each individual should weigh 675 pounds.

Ideally, only replacement heifers with actual heavy weaning weights would be selected. Heavy heifers

Table 4. Reproductive performance for light and heavy heifers when fed separately or as a group (15).

	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%	

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

Feeding group	No. of heifers	Weaning weight	Daily gain to breeding	Projected weight at breeding	Expected in heat (%)		Expected pregnant (%)	
					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
Average		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
Average		472	1.0	687	90	100	63	90

Table 6. The effects of weight at first breeding on reproductive performance in Hereford heifers (17).

	Weight at start of first breeding season		
	Less than 550 lbs.	550-600 lbs.	More than 600 lbs.
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%

need to gain less weight from weaning to the start of breeding to reach target weights. Furthermore, the heaviest heifers will have less calving difficulty, less calf death loss, and higher calf crop percent than will the lightest heifers (14). Additionally, an actual heavy weaning weight reflects a dam with good milk production who calved early in the calving season. Both are highly desirable traits that will be passed on to the heifer to some degree. Nevertheless, some of the lightest heifers are occasionally saved for replacements because of an unusual need for a large number of replacements or because of their value as registered animals. But these heifers still must reach appropriate target weights to have satisfactory reproductive performance.

Recent work has shown that reproductive performance improved when heifers were sorted into light and heavy groups and fed to reach target weights (15) 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 (16).

Sorting heifers into feed groups resulted in a 19 percent increase in cyclic heifers 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 $.03 per head per day. Note, however, that heifers light 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 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 Affects Rebreeding

Feeding virgin heifers to appropriate weights prior to first breeding also influences rebreeding after the first calf. Data in Table 6 Indicate two problems with heifers that are too light at first breeding. Not many get pregnant as virgin heifers and they have much less chance of getting pregnant while nursing their first calves. Note that 90 percent of the Hereford 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 are 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 (18); 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 heifers first calve as 2-year-olds, 46 percent of these heifers experience calving difficulties. Three-year-olds (second calf) experience 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 (19). In herds where first calves are born to 3-year-olds, 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 and 500 pounds, they may not have the ability to produce a calf. Reports on heifer weights just before calving have shown that 36 percent of heifers weighing 625 to 774 pounds had difficulty. 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 (20). Heifers must attain certain minimal size to avoid serious calving problems.

Increased body weight of heifers should not be confused with fattening. In managing for a high reproductive rate the objective is to grow heifers to heavier weights at an earlier age. Studies on the relationship of finish to calving problems have shown that with extremely fat heifers (would have graded high choice or prime) 18 percent of calves are dead at birth and 27 percent die within 24 hours of birth. 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 birth from either the moderate or thin heifers (21).

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 reduced 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.

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, heifers must be well-fed. In other words, feed the heifer to obtain her desired target weight before first breeding, and keep her in a body condition of 5 to 6 from first breeding through first calving and rebreeding.

Table 7. Effect of level of energy fed prior to calving on calving difficulty (21).

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

Table 8. Effects of gestation feed level on dystocia and reproduction in heifers (22).

Sire breeds[a]	Gestation feed level[b]	Postcalving body weight (pounds)	Calf birth weight (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 animals.
[b]Low = 3.5 to 4 lbs. TDN; High = 6.9 to 7.5 lbs. TDN last 90 days gestation.

Table 9. Calving difficulty as related to age of dam, birth weight and sire (23).

	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 (percent)
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

Bull Selection

Calving problems can be reduced by breeding heifers to bulls that sire small calves. The only successful means of sire selection is based upon past performance rather than appearance. This is related neither to the breed nor the size of the bull. The decision is determined by the type of calves produced by the bull. 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 the 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. There are no statistically significant differences in birth weight or calving difficulty between the larger breeds (Charolais, Simmental, Limousin and South Devon). In the smaller breed category, there is no difference between Jersey and Angus, but there are more calving difficulties for Hereford sires.

Such data emphasize the need to take great care when selecting bulls to mate with virgin, and even 3-year-old virgin, replacement heifers; When choosing bulls of any breed, examine the calving ease history of the prospective bull. Look closely at expected progeny differences (EPDs) for birth weight and avoid using bulls whose EPDS for birth weight exceed +4 pounds. If larger frame breeds are mated to smaller frame heifers, it is best to use bulls with EPDs for birth Weight of less than +2 pounds. Also take careful note of the bull's calving ease ratings. Bulls with high calving ease ratings are safe to use on any heifer within that particular breed, provided heifers have been properly grown and developed up to breeding and through first gestation.

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 light birth weight, as do many of their ancestors.

Rebreeding Problems

To increase weaning weights by producing more early born calves, cows and heifers have to breed back soon after calving. Cattlemen have noted for some years that heifers calving for the 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 estrus (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 her smaller size and because her 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. Therefore, heifers with first calf at side should be fed a more nutrient dense feed and at higher levels than that being fed to the mature cow herd. Of utmost importance is to ensure that calving heifers are fed to maintain acceptable body condition and that they not lose weight during calving and rebreeding.

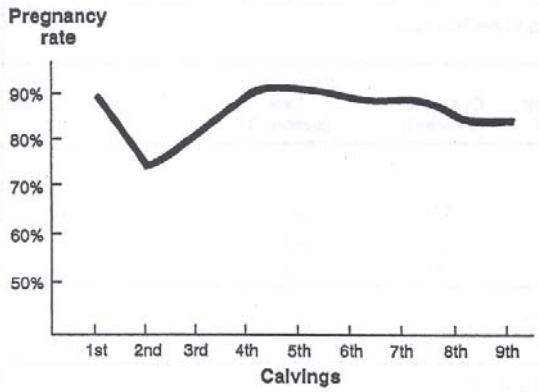

Figure 1. Effect of calving on percent calf crop In beef cattle (24).

Table 10. Percent of cows showing heat at various times after calving (25).

	Days after calving					
	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 (26).

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

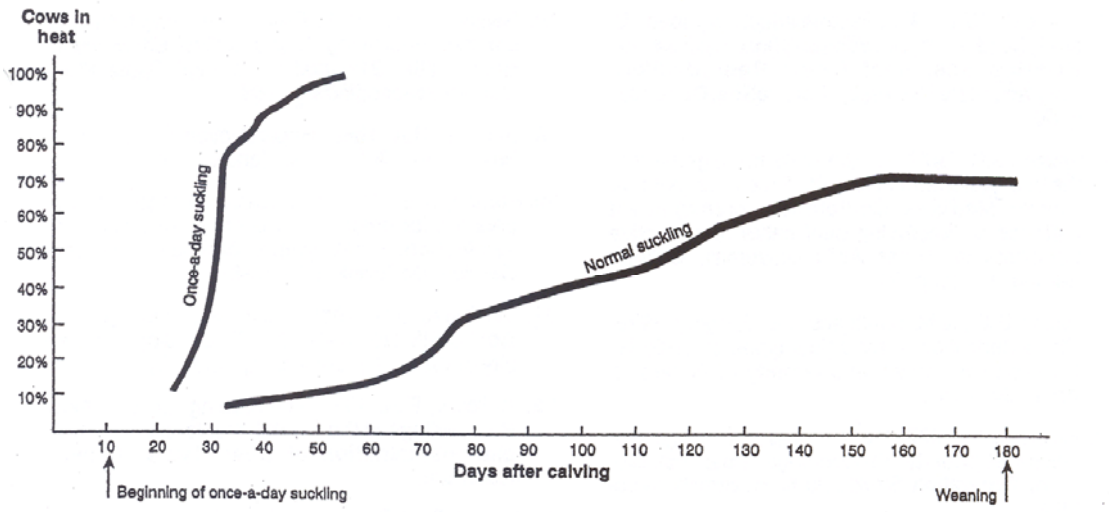

Figure 2. The effect of once-a-day suckling on return to heat in first calf Brahman x Herford heifers (27).

Increase Rebreeding Rates

Three management practices have been shown 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. Calving early gives heifers extra time to return to heat during the second breeding season, which puts them on the same schedule as the regular cow herd. Nevertheless, 30-day early breeding will not help rebreeding rates if the heifers are not properly fed during calving and rebreeding.

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 suck-ling 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 the weight gains of the calves. Complete removal of lactation stress produced a marked Increase In rebreeding efficiency. Even removing only a portion of the suckling stress by creep feeding had a positive effect of pregnancy rates. However, creep feeding may be of little benefit in periods of extreme nutrient deficiency such as can occur during drought.

Studies in Texas have shown pregnancy rates of more than 90 percent in first calf heifers when calves were weaned at 30 to 90 days of age. This can be done without sacrificing calf weaning weights (Table 11). However, the cost of feeding the early weaned calf from 60 days of age to 7 months often is too high and will be influenced by feed prices and forage availability. These factors, as well as cattle prices should be considered in the decision to use early weaning. It maybe that conditions warrant sale of these early wearied calves rather than being held for feeding.

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-dally suckling, and no difference was' noted in health problems.

Summary

Breeding virgin heifers earlier than the mature cow herd providing proper nutrition before and after calving, separating heifers from mature cows, weaning early and implementing one-a-day nursing of calves are effective management methods for improving reproductive performance in heifers during their second breeding Season. 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 critical importance to commercial cattlemen and purebred breeders. Space does not permit a complete discussion of alUactors1hat 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.

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