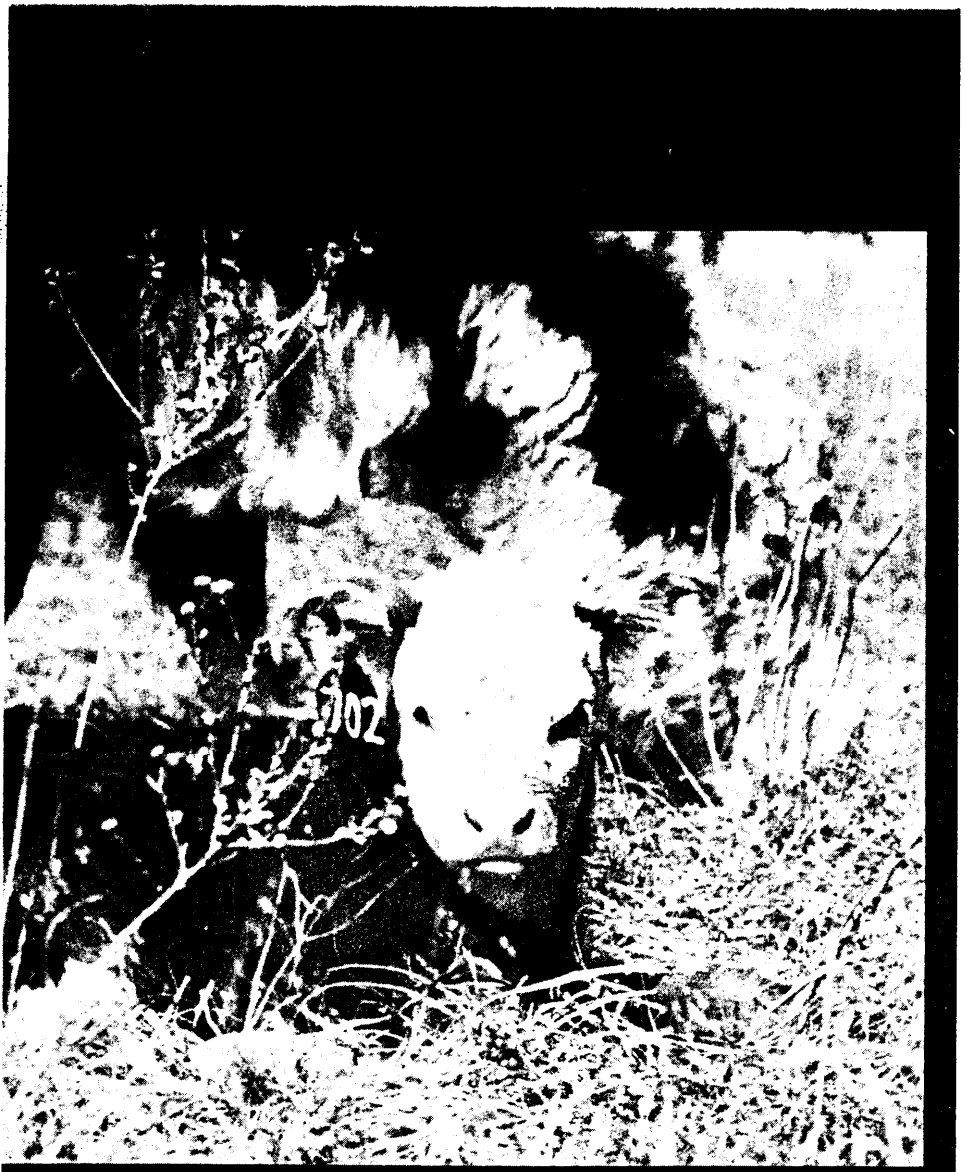

It starts with the calf

Selection and Development of Replacement Heifers

Cooperative Extension Service

Kansas State University

Manhattan

Selection and Development of Replacement Heifers

Since 10 to 20 percent of the cow herd is typically replaced by heifers each year, heifer selection and development decisions significantly affect an operation's productivity and profitability. This productivity and profitability is largely dependent upon reproductive performance as research has shown that heifers calving early in their first calving season continued to calve early and wean heavier calves throughout their lifetime than later calving heifers *(Lesmeister et al., 1973).* In other words, the most productive cows over a lifetime, as measured by actual calf weaning weights, are those that conceive early when bred as yearlings.

The replacement heifer is a mixed blessing for most cow-calf operators. On the one hand, she represents the future profitability and genetic improvement of the cow herd. On the other hand, the replacement heifer is an inconvenience, at best. Her smaller size and higher nutritional requirements dictate that she be raised and managed separately from the rest of the herd. The fact that she is essentially non-productive for the first 2 years of life makes her easy prey for mismanagement. However, the growth and development of the replacement female from birth until she weans her first calf is of critical importance, in order for her to become a highly productive part of the cow herd. Thus, her selection and development is of paramount importance to the continued success of the operation.

The development of replacement heifers can be divided into four phases:

1. **Preweaning**
2. **Weaning to Breeding**
3. **Breeding to Calving**
4. **Calving to Rebreeding**

Preweaning

During the preweaning phase, producers largely depend on the dam to nurture and care for the replacement heifers until weaning. However, the influence of a few management practices should be mentioned. Producers are encouraged to individually identify by ear tag, number brand, etc., both cows and calves, so that selection of replacement heifers can be based upon objective records of birth dates and weaning weights from consistently early calving, high producing cows.

The replacement heifer should weigh at least 450 to 600 pounds at weaning, depending upon breed, frame size and feed supply. However, it is important that this weight be the result of true skeletal and muscle growth without a substantial amount of fat.

A question that often arises during this period is: "What effect would implanting or creep feeding have on future productivity?"

Implanting. Some recent excellent research studies have evaluated the effect of implants during the suckling period on subsequent reproductive performance of replacement heifers. Basically, the summary of the recommendations would be as follows:

a. With any of the current implants cleared, replacement heifers *should* not be implanted at birth or within the first month of birth.
b. Implanting at 2 to 3 months of age appears to have very little adverse effect on subsequent reproductive performance.
c. The multiple use of implants, such as at 2 to 3 months of age and again at weaning, generally tends to have some negative impact on subsequent reproduction in the cattle.
d. In instances where heifers have been kept for later production, there does not appear to be any impaired impact on subsequent level of milk production.

National figures indicate that 16 to 18 percent of the cow herd is replaced annually by heifers. Since half the calf crop is heifers, that means 32 to 36 percent of the heifers serve as replacements, but 64-68 percent are sold as stocker heifers. Not implanting these is a 600- to 700-pound loss in weaning weight per 100 cows, which is enough extra weaning weight to equal a calf and a half.

Since producers typically don't know which heifers will be kept for replacements at implanting time, an easy way to avoid possible problems is to implant only those heifer calves born during the last half of the calving season and selecting replacements from the older group of non-implanted earlier born heifers.

Creep feeding. The concept of creep feeding is basically one of providing extra energy by feeding concentrates or providing a forage creep for suckling calves to

supplement their mother's milk. The key in deciding whether to creep feed or not is whether the inclusion of creep diet will complement the dam's milk production and whether calf and grain prices are such that it will be economically advantageous to creep.

Does creep feeding have a negative impact on subsequent productivity of replacement heifers?

Typically, the recommendation has been to not use creep rations with heifers that will be kept as replacements. That is particularly true in situations where the cows are already good milkers and situations in which a full fed creep will be used where from 3 to 6 pounds of grain is being consumed by future replacement heifers.

It appears that moderate framed, English breed replacement heifers consuming high energy diets from 6 to 8 months of age do suffer altered udder development, causing lipid-deposition which can severely reduce later milk production. In contrast, an extensive summary of the American Simmental Association data by Montana State showed that creep fed Simmental heifers had no reduction in subsequent productivity when compared to non-creep fed heifers.

Weaning to Breeding

A rigorous selection program should be followed at weaning time for prospective replacements, based on available records and visual appraisal. It is highly advantageous to select the early born, growthy heifers, because these females are more likely to be cycling at breeding time as yearlings. This represents indirect selection for fertility and milk production since larger heifers tend to be out of the earlier calving, heavier milking cows. Additional selection criteria may include structural soundness, disposition, fleshing ability muscle expression and frame size.

Traditionally, cattlemen have kept few heifers weaned from first calf heifers. However, for those cattle producers who synchronize estrus and artificially inseminate (AI) their yearlings to high accuracy, progeny-proven calving ease, moderate growth, optimal milk bulls, "keeping heifers from heifers" may have tremendous merit for the following potential reasons:

1. If the yearlings were bred prior to the mature cow herd, heifers from heifers are born earlier and therefore, more apt to reach puberty by the beginning of their yearling breeding season.
2. If sired by calving ease, moderate growth, optimal milk bulls, heifers from heifers should represent the most "balanced trait" genetics in the herd. As mature cows, they can have the ability to restrict calf birth weight even when bred to terminal growth type sires.
3. Heifers from heifers maybe more moderate in frame size and easier fleshing representing less cow maintenance cost.
4. Heifers from heifers may have slower growth rates during the suckling phase with less udder fat deposition resulting in less risk of reduced subsequent milk production particularly in the English breeds.

Puberty consideration. Heifers cannot calve early unless they conceive early and heifers cannot conceive early unless they reach puberty by 12 to 14 months of age, or at least early in their first breeding season. To calve at 22 to 24 months of age, a heifer must reach puberty by 12 to 15 months of age. Heifer puberty is largely a function of age, weight, and genotype *(Table 1)* based on Meat Animal Research Center (MARC) data *(Cundiff, et al., 1985),* which shows tremendous variation in age and weight at puberty due to breeds of sire *(Table 1).* Sire selection, within a breed, also plays a role in determining the age and weight at puberty. Heritability estimates for age and weight at puberty are moderate to high which

TABLE 1. Breed Group Averages for Age and Weight at Puberty

Breed Group	Weight at Puberty (lbs)	Age at Puberty (days)
*** Low-Moderate Growth, Milk:**		
Jersey-x	518	308
Hereford-Angus-x	622	357
Red Poll-x	580	337
South Devon-x	639	350
Tarentaise-x	622	349
Pinzgauer-x	611	334
*** Brahman Influence:**		
Saihwal-x	642	414
Brahman-x	712	429
***High Growth, Milk:**		
Brown Swiss-x	615	332
Gelbvieh-x	626	326
Simmental-x	666	358
Maine-Anjou-x	672	357
***High Growth:**		
Limousin-x	679	384
Charolais-x	703	384
Chianina-x	699	384

From Beef Research Report No. 2: Roman L. Hruska U.S. Meat Animal Research Center and University of Nebraska College of Agriculture.

means that these traits should respond to selection.

One of the most practical methods to decrease age to puberty in heifers both between and within breed is to select daughters of bulls with large scrotal circumference. (MARC) data displayed in *Table 2* shows breed average differences in yearling scrotal circumference and, of greater importance, reduced age to puberty in half-sibs and/or daughters. Genotype difference in scrotal circumference has practical application to the selection of breeds and individual sires within breed for rotational and terminal crossbreeding systems.

Management practices can also influence the onset of puberty. Exposing heifers (from weaning through breeding) to gomerized bulls will reduce age of puberty. In a 2-year Nebraska study *(Roberson et al., 1991)*, 80 heifers were exposed to 4 gomerized bulls and 80 heifers were non-exposed. The bull-exposed heifers reached puberty 40 days earlier with 51 percent pregnant the first 21 days of the breeding season compared to 17 percent of the non-exposed heifers *(Table* 3).

Another management practice that affects puberty is the feeding of ionophores. Research *(Moseley et al., 1977)* has shown that ionophores, such as Rumensin and Bovatec, will hasten onset of puberty in heifers *(Table 4).* Age to puberty decreased and percent cyclicity at the beginning of the breeding season increased in Rumensin fed heifers, resulting in increased conception rate during a short breeding season.

Use of progestin compounds will induce puberty. Melengestrol acetate (MGA), an orally active progestin, has been used by the feedlot industry to keep feedlot heifers out of heat resulting in reduced riding and improved average daily gains and feed efficiency. This same MGA (.5 mg/head/day) can be mixed and fed with supplemental grain to replacement heifers to:

1. Induce cyclicity in some prepuberal heifers that are close; however, have not quite reached sexual maturation possibly due to insufficient weight and/or age.
2. Keep cyclic heifers out of heat until desired as part of an estrous synchronization program.

Another progestin with the same effect is the synchromate B implant.

TABLE 2. Bull Testicle Size Versus Heifer Age at Puberty[1]

Breed	Scrotal Circumference of Yearling Bulls (cm)	Heifer Age at Puberty (days)
Gelbvieh	34.25 ± .5	341 ± 9
Brown Swiss	33.75 ± .5	347 ± 8
Red Poll	33.00 ± .5	352 ± 8
Angus	32.25 ± .5	375 ± 10
Simmental	32.25 ± .75	372 ± 6
Hereford	30.2 ± 5.5	390 ± 13
Charolais	30.00 ± .75	398 ± 7
Limousin	29.75 ± .5	398 ± 6

[1]MARC Data

TABLE 3. Effect of Bull Exposure on Puberty of Yearling Heifers

Group	Age at Puberty Days	Pregnant at 21 Days (%)	Pregnant at 50 Days (%)
Exposed	399	51	86
Non-exposed	439	17	81
Difference	40	34	5

TABLE 4. Effect of Rumensin on Puberty and Conception Rates

Group	No. of Heifers	% Cycling	% Conception
Rumensin	24	92	55
Control	26	58	47

Adequate nutrition. Nutrition from weaning to breeding dictates early heifer conception and subsequent reproductive performance. *Table 5* shows the major nutrient requirements of replacement heifers from weaning to first breeding. This information serves only as a general guide. Weight and body condition should be evaluated periodically to ensure that the heifers are developing sufficiently.

TABLE 5. Major Nutritional Requirements of Replacement Heifers[a]

Body Weight[b]	Daily Gain	Crude Protein Lb/Day	NEm Mcal/ Day	NEg Mcal/ Day	TDN[c] Lb/Day	Calcium Grams/ Day	Phos. Grams/ Day	Vit. A IU/Day
Replacement Heifers:								
400	1.5	1.2	4.10	2.06	6.9	20	11	10,000
500	1,5	1.3	4.84	2.44	8.2	19	12	12,000
600	1.2	1.3	5.55	2.79	8.8	19	13	14,000
700	1.2	1.4	6.24	3.13	9.9	19	14	16,000

[a] Adapted from National Research Council, "Nutrient Requirement of Beef Cattle, " 1984.
[b] Average body weight during feeding period.
[c] The energy (TDN) levels reported are sufficient in relatively mild climates, As a general rule, the amount of TDN should be increased by 1% for each 1°F decrease in the windchill temperature below 30°F for cattle with dry, winter hair or below 55°F for wet or summer hair coats.

The effect of first winter nutrition level on heifer development, reproductive performance and calf production is shown in *Table 6* (Lemen*ager et al., 1980).*

Insufficient postweaning energy supplementation reduced the percentage of heifers breeding as yearlings. Postweaning energy levels affected the weaning weight of the heifers' first calf and reduced the percentage of heifers conceiving for their second calf.

It should be emphasized that replacement heifers need to be fed separately from the rest of the herd. Because of their size and age, as well as higher nutritional demands, they simply cannot compete with the rest of the mature cow herd, nor can they be expected to efficiently utilize poorer quality forages and still breed as yearlings.

TABLE 6. Effect of First Winter Nutrition on Subsequent Performance of Replacement Heifers

	Lbs of Grain/Hd/Day (plus low quality fescue hay)		
Item	0	2.7	5.4
No. heifers	112	113	112
Initial wt. (lbs)	496	502	493
ADG-150 days (lbs)	0.07	0.50	0.80
Breeding wt (lbs)	506	577	613
% bred as yearlings (60 days)	69.2	73.9	83.5
Subsequent Production			
% rebred after 1st calf	67.3	75.4	87.1
Weaning wt 1st calf (lbs)	405	433	443

Purdue, 1980 (3-year summary).

Target weight concept. In general, heifers should be targeted to gain 1 to 1.5 pounds per day from weaning to breeding, depending upon weaning weight, target puberal weight and length of feeding period prior to breeding. Specific target gains can be calculated according to the "target weight" concept and shooting for 65 percent of mature cow size at the beginning of the yearling breeding season.

Example:

Projected mature cow size	1200#
Target yearling breeding weight	780# (65% of 1200#)
Current weight	500#
Current date	October 1
Start of yearling breeding season	May 1
Feeding period	210 days (7 months)
Total gain needed	280#
ADG needed	1.3 ADG

Specific rations can be formulated for target gains of 1.3# ADG and periodic weighing along with ration changes, if needed, will keep the heifers on target.

Kansas State Research *(Patterson et al., 1987)* revealed that if heifers are fed to only 55 percent of target weight, calving difficulty and calf death loss increase and rebreeding for the second calf decreases *(Table 7).*

In short, if spring-born heifers are nutritionally mismanaged during their first winter, penalties include:

- increased age at puberty
- lower conception rates
- increased calving difficulty
- increased calf morbidity and mortality
- later born calves
- lighter weaning weights
- decreased percent rebreeding of first calf heifers
- later rebreeding of first calf heifers
- reduced lifetime productivity

Feeding of weight groups. If the producer has a large number of heifers, work done by *Varner et al., 1977* indicates that reproductive performance can be enhanced by sorting heifers into light and heavy weight groups and fed to reach the same target breeding weight, however, at separate target gains *(Table 8).*

Heifers fed separately were more similar in weight at breeding than heifers fed together. The smaller heifers did not have to compete with the heavier heifers for feed, and feed dollars were allocated to where they did the most good. The light-weight heifers fed separate had a 19 percent advantage in cyclicity at the start of the breeding season, and heifers fed separately had a 15 percent advantage in pregnancy rate over heifers fed together.

Lead breeding. In most cow herds, the most difficult reproductive group of females to get pregnant is the 2-year-old females nursing their first calf. First-calf heifers typically have a 2 to 3 week longer postpartum interval than older females, due to the fact that they are still growing and lactating. This postpartum interval can be even longer if the heifers experience calving difficulty. Therefore, yearling heifers should be bred starting 3 to 4 weeks prior to the mature cow herd. This allows first-calf heifers extra time to start cycling and stay on schedule with the mature cow herd. Calving labor and facilities can be committed to the heifers and the extra age increases weaning weights and makes for a more uniform calf crop.

Short breeding season. Producers are encouraged to retain more heifers at weaning than are needed as replacements to allow further culling at yearling and after breeding. The yearling heifers' breeding season should be limited to 45 days with open heifers culled, another selection criteria. This selects for reproductive efficiency resulting in fertile replacement females that conceive promptly. Late calving first-calf heifers can be a reproductive liability for the rest of their life. Don't worry about a few open yearlings. This represents a form of "retaining ownership" with additional marketing opportunities.

TABLE 7. Effect of Heifer Nutritional Development on Subsequent Performance

% of Mature Weight at Breeding as Yearling	Number	Pre-Breeding Weight	Calving Wt	Calf Birth Wt	Calving Difficulty	Calf Death Loss %
55	60	600	834	70.9	52.3	6.2
65	61	683	897	73.3	28.8	4.5

TABLE 8. Weight Changes and Reproductive Performance for Light and Heavy Heifers When Fed Separate or as a Group

	Fed Together		Fed Separate	
	Light	Heavy	Light	Heavy
No heifers	10	10	19	20
Weaning weight	376	475	374	464
ADG	1.3	1.5	1.8	1.2
Breeding weight				
Target	715	715	715	715
Actual	620	720	670	720
Spread	100#		50#	
Puberty Age (days)	423	404	405	389
% Cyclic (start of breeding)	60	90	79	90
% pregnant in 45 day season	60	80	80	90

Breeding Until Calving

The next step in the profitable management of the replacement heifer is to ensure her adequate growth and development from breeding until she calves as a 2-year-old at about 85 percent of her mature weight. During this time, the bred heifer should gain about ¾ to 1 lb per day or about 250 to 300 pounds. Thus, British bred heifers and crossbred heifers of British breeding should go into the calving season weighing 900 to 1050 pounds and the large-framed

breeds and crosses should weigh 1000 to 1150 pounds. It is preferable to have the heifer growing continuously throughout this phase. For spring calving herds, summer pasture is usually adequate for the first half of this period. However, it is important to recognize that most of the fetal growth occurs during the last 50-60 days prior to calving. Thus, adequate nutrition, especially energy (fed apart from the mature cows), is essential for proper development of the fetus and to prepare the heifer for calving and lactation.

Research at several stations has consistently shown that roughing the heifer the last few months prior to calving results in lighter, weaker calves at birth without any decrease in calving difficulty, greater calf sickness and mortality lower milk production, slower return to estrus and poorer overall reproductive performance. Thus, "shorting" the bred heifer nutritionally prior to calving is an invitation to disaster!

Recent research has studied the effect of protein supplementation on calving difficulty, calf vigor and calf survival. Although researchers in the late 70s thought excess protein supplementation during late gestation might be responsible for dystocia problems, more recent research has not substantiated this theory. Therefore, producers should be warned not to underfeed protein to the gestating heifer in an effort to reduce calving difficulty.

Several studies showed that *low protein feeding during gestation resulted in decreased calf vigor, delayed uterine involution, increased interval to estrus and decreased conception rates following calving.* These problems appear to be compounded when energy is also deficient, illustrating the need for a properly balanced diet.

Restriction of the dam's dietary energy pre-calving will not only have an impact on birth weight, but will have an impact on the calf vigor and the calf's ability to survive and the subsequent growth rate. At the time of calving, the newborn calf moves from a very protected uterine environment to what can be a pretty harsh extra uterine life very quickly.

Since many heifers calve before the cowherd calving, this may occur during cold weather, resulting in a calf that must have the ability to produce heat (thermogenesis) very rapidly after birth. Recent work by Colorado State University showed that restricting the dam's energy level pre-calving did not affect calf vigor but reduced the calf's daily heat production by 11 percent.

Part of this dietary energy effect on calf vigor and its susceptibility to subsequent diseases relates to the decreased calf vigor that results in a calf that is slower to suckle following parturition. It is important to remember that the way that the calf acquires passive immunity is through its initial consumption of colostrum or the first milk presented by the heifer or cow.

To acquire this immunity the calf must nurse shortly after birth for two reasons: 1) the content of the immunoglobulins in the milk decreases rapidly; 2) the calf's ability to transfer the immunoglobulins across the epitheral cells of the calf's small intestine decreases each hour after the calf is born. Dietary energy of the dam prior to calving will have a major impact on how quickly the calf suckles.

Table 9 shows the major nutritional requirements of replacement heifers from breeding through calving. This information can be used as a guide to feeding these females. Body condition and weight should be used to modify the feeding program. Consult KSU Animal Science Bulletin No. C-842, *Feeding*

TABLE 9. Major Nutritional Requirements of Bred Yearlings[1]

Body Weight[2]	Daily Gain[3]	Crude Protein Lb/Day	NEm Mcal/ Day	NEg Mcal/ Day	TDN[4] Lb/Day	Calcium Grams/ Day	Phos. Grams/ Day	Vit. A IU/Day
Bred Yearling Heifers—Last Third of Pregnancy:								
700	1.0	1.3	7.95	.3	8.5	19	14	19,000
800	1.0	1.4	8.56	.3	9.2	21	15	21,000
900	1.0	1.5	9.15	.3	9.9	22	17	23,000

Trace mineralized salt should be provided either free choice in a mineral supplement, or mixed into the ration at 3% of the dry matter to all cattle.

[1] Adapted from National Research Council, "Nutrient Requirement of Beef Cattle," 1984.
[2] Average body weight during feeding period.
[3] About 0.8 lb gain/day during the last third of pregnancy is made up of fetal growth.
[4] The energy (TDN) levels reported are sufficient in relatively mild climates. As a general rule, the amount of TDN should be increased by 1% for each 1°F decrease in the windchill temperature below 30°F for cattle with dry, winter hair or below 55°F for wet or summer hair coats.

TABLE 10. Nutrient Requirements of First Calf Heifers[1,2]

Body Weight[3]	Daily Gain	Crude Protein Lb/Day	NEm Mcal/ Day	NEg Mcal/ Day	TDN[4] Lb/Day	Calcium Grams/ Day	Phos.[5] Grams/ Day	Vit. A IU/Day
750	.5	1.8	9.51	.92	10.8	26	18	30,000
850	.5	1.9	10.11	1.01	11.6	27	19	33,000
950	.5	2.0	10.69	1.09	12.5	28	21	35,000

[1] Adapted from National Research Council, "Nutrient Requirements of Beef Cattle." 1984.
[2] Average milk production (10 lb/day).
[3] Average body weight during feeding period.
[4] The energy (TDN) levels reported are sufficient in relatively mild climates. As a general rule, the amount of TEN should be increased by 1% for each 1°F decrease in the windchill temperature below 30°F for cattle with dry winter hair or below 55°F for wet or summer hair coats.
[5] Trace mineralized salt should be provided free choice in a mineral supplement, or mixed into the ration at 3% of the dry matter.

Your Cows by Body Condition, for more detailed information on ration formulation according to body condition and heifer requirements.

Calving To Rebreeding

Calving is a critical time for 2-year-old heifers since most calving difficulty occurs at this age. Separate the heifers from the mature cows during the calving season and check them every 3 to 4 hours for needed assistance. If a heifer has not delivered a live calf within 2 hours after the water sac appears, she should be examined to determine the need for assistance or possibly veterinary expertise. Prolonged deliveries cause undue heifer stress, increased calf losses, increased postpartum internal and lower rebreeding rate.

Within a few hours, newborn calves should be dried off and nursing colostrum for protection from infections and scours. Calves which fail to nurse within a few hours after birth should be given colostrum stripped from the mother or frozen previously from a mature cow. Purchased colostral products can also be used.

Nutrient requirements of heifers after calving greatly increase because the heifer, unlike mature cows, must lactate, continue to grow and prepare her reproductive tract for rebreeding, hopefully early so that she can calve early again next year. Feed will be used for maintenance, lactation and growth before reproduction. After calving underfed heifers will have longer postpartum intervals and may even fail to rebreed for their second calf. Nutrient requirements for first calf heifers nursing calves are listed in *Table 10.*

Again, this is only a general guide. Genetic potential for milk production greater than 10 lb / day and environment can dramatically increase the heifer's needs. Again, body condition and weight should be used to modify the feeding program. The "eye of the master" still plays an important role in feeding the cow herd.

In spring calving programs, grass is usually adequate several weeks before the mature cow breeding season begins. In situations of high range / pasture grass moisture content, lactating heifers may not be able to consume enough dry matter from grass alone to meet their needs. Insufficient dry matter intake may result in weight loss, preventing early recycling and rebreeding. Supplementing lactating heifers on grass maybe necessary early in the grazing season.

Ideally, first calf heifers should graze separate pastures from mature cows. Running these pairs with yearling heifers may be an option in situations with a limited number of pastures, especially if two-year-old heifers are to be mated to the same calving ease sires as yearlings. Health and vaccination programs apply to first-calf heifers as well. If possible, a further selection of replacement heifers after they have weaned their first calf yields the most confidence in future productivity.

Summary

Heifers developed according to these management techniques have an excellent chance of:

1. Becoming pregnant early in the first breeding season as yearlings.
2. Giving birth to a live calf with minimal difficulty.
3. Raising their calf to an acceptable weaning weight.
4. Breeding back early for their second calf.
5. Continuing to reproduce and wean calves every year for 10 to 12 years.

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