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SELECTION AND DEVELOPMENT OF REPLACEMENT BEEF HEIFERS

by

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INTRODUCTION

Selection, development, management, and nutrition of heifer calves to be used as herd replacements are key factors in maintaining beef herd productivity. A cow/calf producer, to be successful, must have some goals or criterion for heifer selection and development. For practically all Utah cattle production areas, economics dictate that heifers must calve as two-year-olds. Heifers must be properly developed and managed to permit this. The following factors are important: Heifers should 1) become pregnant in the first 25 days of the breeding season, 2) give birth to a live calf with little or no calving difficulty, 3) raise a calf to weaning that has an average or above weaning weight, 4) breed back as a two-year-old in the first 45 days of the breeding season, and 5) continue to reproduce and wean a calf each year until 9 or 10 years of age.

Most cow/calf operators prefer to raise their own replacement heifers. This provides the opportunity to apply positive genetic selection for type, size, adaptability, and maternal traits which are essential in the cow herd. Replacement heifers must be carefully selected to obtain the desired genetics for these desired traits. Heifers must also be properly managed and developed to insure a reproduction level commensurate with the genetic potential they possess.

SELECTION

Heifers selected as replacements must have the genetic make-up that will fit their environment when they are mother cows. This genetic make-up must allow them to

attain satisfactory lifetime reproductive performance under the nutrition and management resources and climatic situation available on a particular ranch.

Important replacement heifer traits are as follows:

1. Proper adaptation
2. Early puberty
3. High fertility
4. Calving ease
5. Optimum milk production
6. Soundness
7. Good disposition
8. Low maintenance requirement

These traits should be evaluated as the heifer progresses through the development and selection process.

The most desirable heifers are produced from cows that consistently calve early and have high production records. Although repeatability of calving interval in general has not been reported as being high, selecting heifers from dams that have weaned a satisfactory calf each year, on time, would tend to maintain adaptability and maternal ability in the herd. Calving regularly and raising the calf to weaning indicates that a range cow is in balance with available feed resource and management system. Daughters tend to be like their mothers. Under most conditions, bulls used to sire most replacement heifers are purchased from purebred herds where feed supplies are abundant. Consequently, there is little selection pressure for adaptation to a range situation on the sire's side, so, a higher level of selection pressure for adaptability must be applied on the dam's side.

When considering the reproductive performance of the dam, allowance must be made for calf losses that arise from such things as scours, predator loss, and accidents. Such

things are largely beyond the dam's control and do not measure her maternal ability.

When the dam production records are not available, replacement heifers will have to be selected on their size, age and appearance at weaning. In small herds where cows and calves have not been individually identified, potential replacements can be selected by observing each pair. Cows that have defects such as swing bags, bottle teats, bad feet, bad disposition, or other undesirable characteristics will probably pass these on to their offspring. Culling daughters whose dams possess these undesirable characteristics will help avoid their build-up in the herd.

Avoid heifers that are young at weaning. These heifers will have a difficult time competing for feed with heifers that are older and will be less likely to reach puberty by the beginning of the breeding season.

DEVELOPMENT

A heifer goes through different phases as she develops. These phases include production, growing, breeding, and rebreeding as a first calf heifer. A closer look at each of these phases and the desired goals to be achieved in each phase will give an overview of satisfactory heifer development.

Production Phase

The production phase is the period from birth to weaning. During this period, the heifer calf depends heavily on her dam to nurture and care for her needs. Producers should individually identify each calf by using an ear tag or number brand or other means of identification.

Excessively fat heifers are not desired for replacements. If heifers become excessively fat during this stage of their development, their ability to produce milk may be reduced making them poor mothers at a later date. If heifers become overly fat it would indicate that their mothers are giving excess amounts of milk for the growth potential of the calf.

Growing Phase

The growing phase of heifer development covers the time period from weaning to breeding. This phase is the most critical in the life of a heifer. If a heifer does not grow properly during this phase of her development, the chances of becoming a productive individual in her later life are seriously reduced. A heifer must reach puberty by the time

she reaches 12 to 14 months of age. Since puberty is influenced by age, weight, and breed, it is important to have a breeding target weight in mind for heifers. Age and weight at puberty for heifers of different breeds is shown in Table 1. An average weight at puberty and a target weight at which 85 to 90 percent of the heifers will be cycling is also indicated. Reaching the target weight is very important at this stage of development if a breeding program is to be successful.

Table 1. Age and weight at puberty for crossbred heifers of different breeds.

	Ave. Age at Puberty (days)	Ave. Wt. at Puberty (lbs.)	Target Wt. (85 - 90% cycling) at 12-14 months
Hereford Straight	365	630	690
Angus Straight	361	625	685
Gelbvieh - X	326	626	750
Brown Swiss - X	332	615	750
Pinzgauer - X	334	611	700
Red Poll - X	337	580	650
Tarentaise - X	349	622	675
South Devon - X	350	639	725
Hereford-Angus - X	357	622	675
Maine-Anjou - X	357	672	750
Simmental - X	358	666	750
Limousin - X	384	679	775
Chianina - X	384	699	775
Charolais - X	384	703	775

Meat Animal Research Center, Clay Center, NE

With these target weights in mind, the following calculations may be useful in determining how much a heifer will need to gain from weaning to breeding.

Desired weight - weaning weight / days between weaning and breeding

For example: A heifer weighs 500 pounds at weaning (205 days) and the target weight is 725 pounds at 13 months (approximately 390 days). There are 185 days in this period. The heifer would need to gain an average of 1.22 pounds a day to reach the desired weight.

$$\frac{725 - 500}{185} = 1.22 \text{ pounds per day}$$

Breeding Phase

The breeding phase of heifer development starts at the beginning of the breeding season and concludes when the heifer becomes pregnant. This phase of heifer development is also important. Under most management systems, it is advantageous to start breeding replacement heifers 20 to 30 days prior to the breeding season for mature cows. Heifers should be bred to low birth weight bulls. Bulls that will transmit low birth weights can be determined by using "EPD" values. This information is becoming available on a larger number of bulls each year. Evaluating the accuracy of this data is important. In young bulls, the accuracy of the "EPD" for birth weight may not be very high. Accuracy of "EPD" for birth weight becomes more reliable as bulls become older and records on more progeny become available. Where "EPD" information is not available, the birth weight and yearling weight of the bull being considered may be useful. Do not use bulls that are breed average or above in yearling weight on first calf heifers.

Another important selection tool that can be used during the breeding phase of heifer development is pelvic measurement. Pelvic size has been shown to have a linear growth pattern from 9 to 24 months of age in heifers calving at two years of age. Therefore, pre-breeding pelvic area could be used as an indicator of pelvic size at calving. Pelvic measurements should be taken when heifers are 12 to 13 months of age. This information, along with birth date, weaning weights, and other information can serve as an aid in making the final decision on which heifers to breed and which bulls to use.

Pelvic measurements (Figure 1) are obtained by using a calibrated instrument to determine the height and width of the pelvic area. These values are multiplied together to give the approximate pelvic area in square centimeters. A typical yearling heifer will have a pelvic area of 140 to 170 sq. cm. The average growth of the pelvic area from yearling to calving is approximately .25 cm² per day. Pelvic area measurements can be used to identify heifers with small pelvic areas that have a predisposition for calving difficulty. Selecting heifers with larger pelvic areas should result in increased pelvic area in the herd, since heritability of pelvic area is quite high. Producers should use caution in using pelvic measurements as the only selection criterion.

Researchers have found a positive genetic correlation between pelvic area, birth weight, and future animal size. This indicates selection applied for larger pelvic area in yearling heifers must be applied among heifers of the desired mature size potential. Otherwise, there will likely be an accompanying increase in mature cow size and calf birth weight.

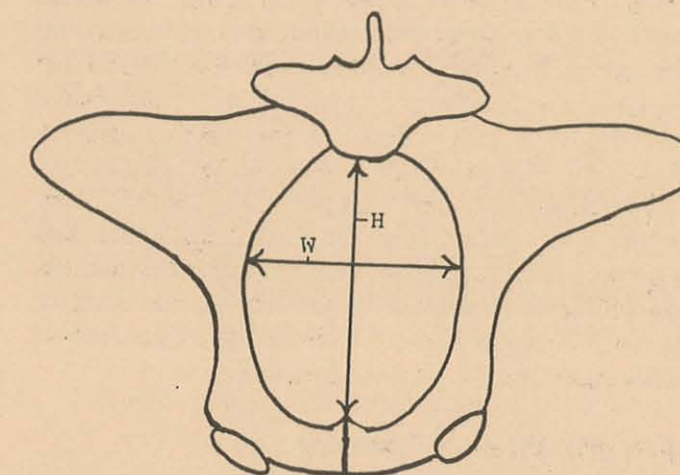


Figure 1: Internal measurements to obtain pelvic opening.

Height (cm) x Width (cm) = Total Pelvic Area (cm²)

Rebreeding as Two Year Olds

The rebreeding phase of heifer development includes those activities to insure that a heifer will calve out properly and rebreed for her second calf. This final phase of the development of replacement heifers insures that adequate growth and development occurs from the end of the breeding season until the heifer calves as a two-year-old and rebreeds. During this period of time, a bred heifer should gain .5 to .75 pounds per day or 100 to 150 pounds. She should be growing continuously during this phase and should reach approximately 85 percent of her mature weight. Adequate nutrition, especially energy, is essential for proper development of the fetus and to prepare the heifer for calving, lactation, and rebreeding.

MANAGEMENT

The following suggestions may be useful when selecting heifers at various stages in their development. It is important to save more replacement heifers at weaning time than you intend to place into your cow herd. Having these additional heifers available provides an opportunity for more rigid culling at all stages of heifer development and assures the desired number of superior individuals to add to the cow herd. Usually, retaining extra heifers does not result in an economic loss because heifers continue to gain and will provide economic return when they are culled from the herd. At weaning, remove the small heifers that will not achieve the necessary size to reach puberty and cycle at breeding time. Heifers having the potential to become too large to fit within available resource limits should also be considered for culling. Heifers that have

poor general conformation, faulty feet or legs, bad disposition, or other apparent undesirable characteristics should be removed. Just prior to breeding, cull those heifers that have not attained the desired target weight or desired frame size. In general, cull heifers that subsequent pregnancy testing shows did not conceive within 45 days (desired) or 66 days (maximum) after being put with the bulls. Evaluate again after calving. Mark for later culling, heifers that do not properly mother their calf, have insufficient milk, have problems at calving or produce an abnormal or otherwise undesirable calf. Heifers that do not rebreed readily should also be marked for culling.

Birth Weight and Dystocia

Dystocia, difficult calving, is a problem with first calf heifers. The two major factors affecting calving difficulty are, first and most importantly, birth weight of the calf and, second, pelvic area of the heifer. Selecting heifers with birth weights 10 percent heavier than average is not recommended. Selection of these heifers will put pressure in the direction of heavier birth weights. This can lead to increased calving difficulty and also toward increased cow size.

Average birth weights of calves from cattle breeds commonly used on western ranges are given in Table 2. These figures should be used only as a starting point, however, since many breeds have continued to increase in size during the past few years and birth weights have also increased.

Table 2. Average birth weight of calves for selected breeds^a

Breed	Birth Weight ^b (Pounds)
Angus	70
Brangus	70
Charolais	83
Gelbvieh	82
Hereford	77
Limousin	80
Maine-Anjou	84
Murray Grey	60
Shorthorn	70
Simmental	83

^a Taken from Guidelines for Uniform Beef Improvement Programs, 1986.

^b Mature cows

Number of Replacements

The number of replacement heifers needed to maintain a constant cow herd size is dependent on death loss level in the cows, longevity of individual cows, and the level of culling for production reasons that is imposed. Normally 12 to 16 replacement heifers will be needed each year for every 100 cows in the herd.

Puberty

Puberty marks the beginning of an animal's ability to reproduce and is indicated in heifers by their first estrous or heat cycle. Heredity (breed) influences age at puberty. Nutrition also plays a key role in determining when a heifer reaches puberty. Level of nutrition will affect weight for age and also body fat levels. Both of these factors have a definite relationship on when a heifer reaches puberty.

Larger breeds tend to be older at puberty than smaller breeds. There is some evidence that cattle with higher milk production arrive at puberty earlier than cattle of similar size but of lower milk producing ability. For example, Simmental crosses arrive at puberty some 26 days earlier than Limousin and Charolais crosses which are of comparable size to the Simmental crosses but are lower in milk production.

Many purebred breeders are increasing size in their cattle. These larger heifers should be expected to arrive at puberty at a somewhat older age than moderate size heifers. There is a tendency for crossbred heifers to reach puberty slightly earlier than straight-bred heifers. The exception to this is when one of the parents of the crossbred is a Brahman. Brahman crossbreeds are markedly later in reaching puberty than are non-Brahman crossbreeds.

Size and Age

Heifers calving as two-year-olds are under heavy physiological demands for a long time. They must support a pregnancy that commences when they are 14 months old. After parturition, lactation imposes heavy demands; yet, the heifer must quickly prepare for another pregnancy. Through all of this, they must continue to grow and develop body size. Nature has provided that pregnancy and lactation demands take precedence over growth. Therefore, if nutrients are limited during lactation, reproduction will be delayed. The delay may be weeks, months, or even a year, depending on the severity of nutrient shortage.

The amount of daily gain desired for a post-weaning heifer is related to the mature size potential of the heifer. For example, heifers, having a mature size potential of 1,000 pounds do not need to gain as much per day as heifers of potential mature size of 1,300 pounds. If heifers are to

Table 3. Mature cow size and related weight for age and winter daily gain.

Mature Cow Size (Moderate Condition) lbs.	Expected Weaning Weight (205 Days) lbs.	Weight at 427 Days Age Beginning of Breeding Season		Necessary Winter Daily Gain lbs.
		Minimum (60%) of Mature Wt. lbs.	Preferred (63%) of Mature Wt. lbs.	
950	399	570	599	.89 - 1.04
1000	420	600	630	.94 - 1.10
1100	462	660	693	1.03 - 1.20
1200	504	720	756	1.12 - 1.32
1250	525	750	788	1.17 - 1.38
1300	546	780	819	1.22 - 1.42
1400	588	840	882	1.31 - 1.53

attain 65 percent of their mature size at 14 months, they must gain 0.094 to 0.11 percent of their potential mature size per day throughout the (approximate) 192 day post-weaning period.

Table 3 shows the expected weights and daily gain rates required during the post-weaning period in order to attain the indicated sizes at 14 months (427 days) of age. Gaining at a uniform rate throughout this period is desirable. Periodic weighing to determine rate of gain is helpful. In general, heifers do not need to increase in fatness during this period. However, they should maintain a condition at least equivalent to that at weaning time.

During their second winter, heifers calving at two years of age require better feed than mature cows. They must continue to grow as well as maintain their body and a growing fetus. See Pamphlet No. EC 421, "Optimizing Range Cows' Productiveness," for a discussion of this.

Sire Selection

Good sire selection is also important for producing heifer replacements. Most of the improvement in a cow herd will come from sire selection. Dr. Jim Brinks at Colorado State University gives the following suggestions on sire selection:

"The first step in sire selection is to determine the mature size and level of milk production that best fit available feed resources. To ensure optimum values, sires with highly accurate EPD values for growth and milk should be used. Determining appropriate size and milk levels for an environment is not simple. Experience with bulls with varying EPDs may be the best guide. As a start, however, consider bulls which will sire calves with frame scores greater than six as too

big. Frame scores of five and six are more acceptable from a market standpoint.

"Yearling scrotal circumference of prospective herd sires should receive special attention to improve reproductive potential in female offspring. Research has shown that sires with above average scrotal circumference as yearlings should produce heifers with earlier puberty and better subsequent reproduction.

"Pelvic measurements can also be taken on yearling sire prospects. Bulls with small pelvic areas should be avoided to prevent calving difficulty in future generations of heifer offspring. In addition, sires to be used on heifers need to be selected for moderate birth weight and calving ease EPD values in order to avoid calving difficulty.

"Remember, sire selection is the single most important step in producing a set of quality replacements."

NUTRITION

Feeding Heifers to Calve at Two Years of Age

Nutrition also plays a key role in the development of high-quality heifers. Adequate nutrition must be provided during all phases of a heifer's development if she is to express her genetic potential. Mistakes in any phase of development can prove disastrous. Weanling heifers require higher quality feed and more feed per unit of body size than do mature cows. No winter range in Utah will adequately provide the needed nutrition for weaning heifers. If they are to graze on the range, proper supplementation is essential. Usually, it is preferable to feed heifers in a pen or corral where mangers and some shelter, at least a windbreak, is provided. In very cold areas, weanling

heifers may not make satisfactory growth even when liberally fed and some shelter is provided. In such cases, it is preferable to move them to a milder climate for wintering. In less extreme temperature conditions, heifers will do well when a pen with mangers and protection are provided and are also given liberty to go out and graze. Water should be freely available under all conditions.

A study at the USDA Livestock and Range Experiment Station at Miles City, Montana, emphasizes the interrelationship between nutrition and future reproduc-

tion. Study the data in Table 4 carefully. Marked differences in weight gains in winter and summer are related to the first winter's nutrition. Note that 20 percent of these low-plane heifers failed to come in heat during the breeding season. Actual pregnancy levels were 50, 80, and 87 percent for the low, moderate, and high planes of nutrition, respectively. Only 30 percent of the heifers in the low-plane group conceived during the first 20 days of the breeding season as compared to 62 and 60 percent for the other two groups.

Table 4. Summary of feed effects on heifer reproduction.^a

	Winter Low	Gain Moderate	Group High
Winter gain (lb/day)	0.6	1.0	1.5
Summer gain (lb/day)	1.3	1.2	0.9
Body weight (lb)			
End winter (5/6)	414	481	558
Begin breeding (6/15)	458	527	584
Fall (10/15)	629	667	708
Age puberty (days)	434	412	388
Percent showing first heat			
Before breeding season	7	31	83
During breeding season	73	66	17
After breeding season	20	3	0
Percent conceived			
First 20 days	30	62	60
Second 20 days	10	21	20
Third 20 days	10	3	7
October pregnancy (%)	50	86	87

^aAdapted from USDA Livestock Range Research Station, Miles City, Montana, data.

If a heifer is to become a good producing cow, she must calve early in the calving period with her first calf. The Montana data indicates the need for adequate nutrition to enable the heifer to conceive and calve early.

The requirement for Daily Dry Matter Intake, Total Digestible Nutrients (TDN), and Crude Protein (CP) needs for various levels of gain are shown in Table 5.

Table 5. Daily nutrient requirements for developing replacement heifers from weaning to breeding.^a

	Weight (lb.) ^b	Dry Matter Intake (lb.)	Daily Gain (lb.)	TDN (lb.)	CP (lb.)
Medium frame	500	11.8	1.0	7.3	1.11
		12.1	1.5	8.3	1.25
		11.8	2.0	9.1	1.35
	600	13.5	1.0	8.4	1.19
		13.8	1.5	9.5	1.32
		13.5	2.0	10.4	1.41
Large frame	500	12.4	1.0	7.3	1.16
		12.9	1.5	8.3	1.32
		11.1	2.0	9.1	1.46
	600	14.1	1.0	8.3	1.25
		14.8	1.5	9.5	1.41
		14.6	2.0	10.4	1.54
	700	15.9	1.0	9.4	1.34
		16.6	1.5	10.6	1.49
		16.8	2.0	11.7	1.61

^aAdapted from NRC, 1984.

^bAverage weight during feeding period.

Many suitable diets can be developed for weaning heifers. Availability and cost of feeds are important factors. If range forage is to be a major source of feed, the nutritive value of the range forage should be determined. An experienced cattleman can estimate the value of the range vegetation by determining the relative abundance of the various plant species. A proper supplement and rate of supplementation can then be derived. Continuous careful inspection of the heifers by a skilled manager is essential to insure that the animals are growing and gaining as desired. Periodic weighings, if practical, are helpful.

Many Utah ranchers have increased the size of their cattle over the past 15 to 20 years. Remember that heifers of large mature size potential require more feed per head per day than heifers that are of moderate mature size potential. In general, similar diets can be fed; but more of the diet is needed.

Other sample diets, as shown in Table 6, for medium frame heifers are as follows:

Table 6. Diets for heifers.

Ration	Daily Feed
Corn silage	20 pounds
Alfalfa hay	7 pounds
Grain - no gain needed	
Corn silage	20 pounds
Grass hay	7 pounds
Supplement	.5 pounds (Cottonseed meal or Soybean meal)
Grass hay	12 pounds
Grain	2 pounds (Barley or equivalent)
Supplement	.5 pounds (Cottonseed meal or Soybean meal)

The amounts given are the averages for the wintering period. In practice, about 75 percent of this amount should

be fed early in the winter when the heifers are small. At mid-winter, the amount fed would be about 1.25 times the average amount fed during the last part of the winter season. Carefully watch the heifers to determine growth and condition. Producers should consider the use of Ionophores (Rumensin or Bovatec) in their feeding program. Research shows that heifers fed these products reach puberty earlier due to increased weight gains. Remember that a heifer should reach approximately 65 percent of her mature weight prior to breeding.

CONCLUSIONS

Good replacement heifer development requires serious attention of the manager. If heifers are neglected in any stage of development from birth to breeding back as two-year-olds to produce a second calf, productivity can be impaired for the rest of their lives. Selection of sires for potential replacements is also important. If heifers are properly developed and have the right genetics, heifer selection is relatively easy. Nutrition and management play a key role in determining if the genetic potential of a heifer can be expressed.



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