INTEGRATED REPRODUCTIVE MANAGEMENT

PART III. THE REPLACEMENT HEIFER

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Selecting replacement heifers and managing them correctly is one of the major challenges to the cow-calf producer. There is an estimated 16 percent turnover each year in the mature cow herd due to death, rebreeding failures, poor production and age. A minimum of 30 to 40 percent of the heifer calves born are needed to replace those cows lost or culled. Heifer calves are the product of the time, money and dedication the producer has spent in managing the cow herd.

Selection

The replacement heifer is the raw material for future cow herd productivity. Selection of these individuals should be for traits which make progress toward the goals each producer has established for his cow herd. The traits normally selected for are performance related. Performance normally is measured in terms of each animal's weight advantage above their herdmates. The performance criteria generally used are 205-day weaning weights and weight per day of age. Another trait to be monitored is the period of the calving season in which the heifer was born. Heifers born early in the calving season usually are heavier at weaning and reach puberty earlier than herdmates born late in the calving season. Retention of early born heifers in the herd should result in females genetically superior to their herdmates in the reproductive traits. The traditional procedure of visual selection for structural and reproductive soundness, conformation and femininity should not be disregarded.

Utilization of a number of these selection procedures assumes the producer is involved in some type of performance testing program. Selecting the "right" heifer is the first step in developing the replacement heifer. Performance testing records are invaluable in the selection process. Trying to select replacement stock without performance records is like trying to build a house without a blueprint. Visual appraisal and pedigree should not be discounted, but they should be used as only part of the selection process. Several performance testing programs are available. Most national purebred organizations offer this service as well as the North Dakota Beef Cattle Improvement Association. Performance testing is an excellent tool for producers genuinely interested in improving the productivity of their cow-calf enterprise.

Weaning weight of calves is positively correlated with milk production of the dam. By selecting growthy, fast gaining heifers the producer is automatically selecting for milk production. Heavier heifers at weaning will also require less feed to attain puberty. Overfat heifers, however, have more difficulty calving, produce less milk, and have a lower lifetime production of calves than heifers in only good condition. Weaning weight of heifers has a direct effect on their future reproductive performance. In a recent Florida research trial, heifers with weaning weights under 350 pounds had a 69 percent calf crop; those in the 350 to 399-pound range had a 67 percent calf crop; 400 to 449 pounds, a 77 percent calf crop; 450 to 499 pounds, an 87 percent calf crop; and 500 to 599 pounds a 90 percent calf crop.

Puberty

Age, weight and breed have a direct influence on when a heifer will reach sexual maturity. To calve as a two-year-old, she must be bred by 15 months of age (Tables 1 and 2).

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Table 1. Effect of Age on Puberty

	Percent in Heat		
	Age in Months		
	13	14	15
Hereford	38	65	77
Angus	76	80	92
Angus x Hereford	74	82	97

Source: Wiltbank (1970)

Table 2. Weight of Heifers as Related to Puberty

Weight of Heifers (lb)	Percent Having Reached Puberty		
	Hereford	Angus	A x H
450	—	—	—
500	—	8	—
550	—	44	18
600	27	72	43
650	50	84	68
700	62	88	78
750	88	100	93

Source: Wiltbank (1970)

A general rule of thumb to attain high conception rates on first breeding is to have heifers weighing 65 percent of the average mature weight for the breed. The heifer should weigh approximately 85 percent of her mature weight at calving.

Studies at the US-MARC indicate that crossbred heifers of the exotic breeds should be at least 14 months of age before initiation of breeding to maximize the percentage of heifers cycling. In addition, they should be in the 750 to 775-pound range at the start of the breeding season (Table 3).

Table 3.

Post Weaning Growth and Puberty (1970-71-72 Calf Crops)

Breed Composition	550 Day Wt.[B]	Puberty Age	[C]Adjusted Puberty Wt./ lb.
	(lbs)	(days)	
Hereford x Hereford	677	420	618
Angus x Angus	694	367	567
Hereford x Angus[A]	721	377	588
Jersey x	660	328	487
South Devon x	740	365	602
Limousin x	720	399	644
Simmental x	776	369	637
Charolais x	779	399	673
Average	726	376	603

Source: USDA Clay Center (1973)

[A]Represents a reciprocal cross of both Hereford x Angus and Angus x Hereford. The rest of the crossbreds were averages from both Angus and Hereford dams. (e.g. Jersey x Hereford and Jersey x Angus).

[B]Adjusted 550 day weight = 200 day weight + (350 day postweaning A.D.G. x 350 days) adjusted for year + birth date.

[C]Adjusted to comparable values if puberty had been detected in 100% of the heifers in all breed groups.

Nutrition

Nebraska research demonstrated wintering heifers on a low level of energy to gain 0.8 pounds per day resulted in only 45 percent showing heat by 14 months and 68 percent by 15 months of age. In comparison, feeding heifers to gain 1.6 pounds a day resulted in 98 percent of the heifers in heat by 15 months of age.

Assuming the average mature weight of cows in North Dakota is between 1050 and 1100 pounds, 65 percent of the mature cow weight would mean that heifers should weigh about 700 pounds at breeding (June 1). Heifers weighing 425 pounds at weaning (Nov. 1) must gain 275 pounds from weaning to breeding. If heifers are weaned in November and breeding begins on June 1, they have approximately 210 days to gain 275 pounds. This requires a 1.3 pound average daily gain from weaning to breeding.

The date heifers go to pasture in the spring will vary with weather and pasture conditions. Heifers going to grass May 1 have a winter feeding period of approximately 180 days (Nov. 2 through May 1).

Pasture gains of 0.75 to 1.4 pounds daily can be expected, bringing the heifers to 700 pounds by breeding. Good pasture should be sufficient for proper gains. However, short pastures and overstocking often result in insufficient gains or weight losses during breeding season. If these conditions are noticed, feed 3 to 5 pounds of grain per head per day to get the heifers gaining weight.

Nutrient requirements for growing heifer calves based on various weights and daily gain are listed in Table 4.

These are minimum nutrient requirements. Very few heifers are grown under optimum conditions, and adjustments to these requirements may be necessary. One adjustment that must be made is for variations in temperature. Heifers will need more energy to maintain their body temperature with the cold winter conditions of North Dakota. The rule of thumb is for every 1 degree drop in temperature below freezing, the nutrient requirements increase by 1 percent. The wind-chill index may be a better guide than the ambient temperature reading alone.

Economics

What are the costs involved in producing a replacement heifer? While actual costs will vary considerably among producers, the following example provides an indication of these costs. For this example, costs were separated into two time periods: 1) from conception of a cow to weaning of its heifer calf and 2) the time period from weaning until breeding of the heifer calf. At this time the heifer is considered a replacement — it is being bred to replace a cow that had died or is being culled.

Table 4. Minimum Nutrient Requirements for Growing-Finishing Heifer Calves and Yearlings (Nutrient Concentration in Diet Dry Matter)*

Av. WT. For Feeding Period (lbs)	Daily Gain (lbs)	Minimum Dry Matter Consumption** (lbs)	Total Roughage (%)	Protein (%)	(lbs)	TDN (%)	(lbs)	Ca (%)	P (%)
331	1.1	9.0	70-80	11.0	.99	61	5.5	.34	.29
	1.5	8.8	50-60	12.4	1.09	69	6.1	.45	.35
	2.0	8.8	25-30	13.5	1.19	77	6.8	.57	.42
441	1.1	13.2	80-90	9.6	1.27	58	7.7	.23	.22
	1.5	13.2	70-80	10.2	1.35	64	8.4	.30	.27
	2.0	11.7	35-45	11.7	1.37	75	8.8	.41	.32
551	1.1	14.3	80-90	9.5	1.36	58	8.3	.20	.20
	1.5	12.8	55-65	10.5	1.34	72	9.2	.29	.26
	2.0	13.0	35-45	11.1	1.44	77	10.0	.36	.29
661	1.1	16.3	80-90	9.2	1.50	61	9.9	.19	.19
	1.5	14.6	55-65	10.1	1.47	72	10.5	.24	.23
	2.0	15.0	35-45	10.4	1.56	77	11.6	.28	.25
772	1.1	18.3	80-90	8.7	1.59	61	11.2	.18	.18
	1.5	17.4	55-65	9.2	1.60	69	12.0	.19	.19
	2.0	17.9	35-45	9.5	1.70	75	13.4	.21	.21

*Adapted from NRC Requirements for Beef Cattle.
**Dry matter consumption and TDN allowances are based on NE requirements and the general type of diet indicated in the roughage column.

The costs associated with the first time period (conception to weaning) can be estimated through the use of a concept called opportunity cost. Opportunity cost is the value of a resource in its highest valued alternative. For example, the heifer calf could be sold rather than retained as a potential replacement. The income that is forgone by **not** selling the calf is an opportunity cost — the cost of giving up the opportunity to obtain the sales value of the calf. In addition, there is an opportunity cost associated with giving up the potential to earn a return with the income from a calf sale. In this example, it was assumed that the heifer calf, weighing 425 pounds, **could** have been sold for 68 cents a pound, or $289.00. Without considering marketing expenses, $289.00 is the initial opportunity cost of **not** selling the calf. It was also assumed that a 14 percent annual return **could** have been earned on that income if it were available and invested elsewhere. Total cost for the conception to weaning time period was $309.23, computed as follows:

Value of calf	= $289.00
+ 14% of value for 6 months (June 1-November 1)	= 20.23
Total	$309.23

The second cost phase is from weaning to the time the heifer is bred as a replacement. Costs in this category include feed and pasture, labor, veterinarian and other medical, fuel, death loss and a variety of miscellaneous expenses.

The producer developing a replacement heifer has a substantial investment in the weaned heifer calf prior to the winter feeding period. Proper precautions should be taken in the selection and development process to ensure that heifers will cycle and settle in the shortest period of time in the breeding season. If they do not become pregnant, **and not all of them will,** these costs must be borne by those heifers which do conceive and come into production as two-year-olds.

The AGNET computer system software programs FEEDMIX and BEEF were used to prepare a budget for developing replacement heifers. Feed accounts for a majority of the costs during the wintering period, so it is mandatory to feed them as cheaply as possible without being detrimental to the final performance. The FEEDMIX program is a least-cost ration analysis program. The following feeds and their prices were used for this analysis:

Corn	$ 2.30/Bu
Alfalfa	$ 50.00/Ton
Corn Silage	$ 18.00/Ton
Oat straw	$ 20.00/Ton

The following growing ration was generated using the above ingredients (Table 5), providing the cheapest possible ration while meeting the nutrient requirements of the heifer.

Table 5.

Feed Name	Lbs/ Unit	Moisture %WB	Your Price	Ration (%) As Fed	Lb/HD/Day Dry	Lb/HD/Day As Fed	Ration 100% Dry
Corn Bu	56	14.00	2.30	7.04	1.65	1.92	10.99
Hay Alf. MB	2000	10.00	50.00	21.59	5.29	5.88	35.27
Oat Straw	2000	10.00	20.00	8.25	2.02	2.25	13.48
Sil Corn	2000	65.00	18.00	62.97	6.00	17.14	40.00
Phos. Dical	2000	0.0	300.00	0.15	0.04	0.04	0.26
	Totals			100.00	15.00	27.22	100.00
Ration Cost	Dry Basis 2.72 $/CWT 54.45 $/Ton		As Fed Basis 1.50 $/CWT 30.00 $/Ton		Moisture Content 44.90% (55.10 %DM)		

The cost of this ration is $30.00/ton on an as-fed basis. The ration analysis is as follows:

Table 6. Nutrient and Quality Analysis for This Mix.

Requirement No.	Name		Required	Actual	Lbs DM/Day Basis Required	Lbs DM/Day Basis Actual
1.	WEIGHT	EQ	100.00	100.00	15.00	15.00
2.	CRUDE P	MIN	10.50	10.50	1.57	1.57
3.	NEM	MIN	0.0	65.96	0.0	9.89
4.	NEG	MIN	35.00	35.00	5.25	5.25
5.	TDN	MIN	0.0	63.47	0.0	9.52
6.	CALC	MIN	0.30	0.68	0.04	0.10
7.	PHOS	MIN	0.25	0.25	0.04	0.04
8.	POTASS	MIN	0.0	1.38	0.0	0.21
9.	MAGNES	MIN	0.0	0.27	0.0	0.04
10.	SULFUR	MIN	0.0	0.17	0.0	0.03

10.5% Protein — 1.57 lbs. Crude Protein/15 lbs D.M.
35 MCal NEg/100 lbs.

This example ration is not intended to be perfect for every situation. Local prices, feed availability and nutrient compositions of feedstuffs affect least cost rations. Producers should have a nutrient analysis conducted on their feedstuffs. The local county agent can perform a least cost ration analysis tailored to the producers individual needs.

The AGNET BEEF program was used to project the costs and feedlot performance of these heifers on the sample ration. This program predicted performance of the replacement heifers based on the following inputs:

1. Bismarck 10 yr. avg. weather data
2. 15 cents per day non-feed costs.
3. $68.00/Cwt. heifer value
4. 14 percent interest rate.
5. Initial weight — 425 pounds.
6. Final weight — 660 lbs.
7. Frame score — 2.5 out of a possible 4.
8. Condition score-average.
9. Ten day adjusment period.
10. NEg = 35 MCal/cwt
11. NEm = 65.96 MCal/cwt.
12. Lot conditions (mud factor) is 0.
13. Feed costs in $/dry cwt. = $2.72.
14. Start on feed Nov. 1.

The following data resulted from these inputs (Table 7).

Table 7. Projected Feedlot Performance, Bismarck, North Dakota.

Date	Ave. Temp.	Current Feedlot Weight	Gain This Period	Gain Average To date	Cost/lb Gain (Cents) Average Dry Feed Intake	Cost/lb Gain (Cents) Average Efficiency	Cost/lb Gain (Cents) This Period	Cost/lb Gain (Cents) To Date
11 28	29.3	455.72	1.10	1.10	12.37	11.27	54.57	54.57
12 26	16.9	490.07	1.23	1.16	13.09	10.67	50.42	52.38
1 23	6.9	517.82	0.99	1.11	13.71	13.83	64.08	55.88
2 20	9.4	552.91	1.25	1.14	14.31	11.42	52.00	54.82
3 20	22.5	595.44	1.52	1.22	15.07	9.92	44.26	52.18
4 17	35.8	643.06	1.70	1.30	15.90	9.35	40.86	49.71
4 27	42.4	660.11	1.71	1.32	16.52	9.68	41.72	49.13
		Total		235.11	2529.61			
		Average		1.32	14.21	10.76		

These data indicate the average daily gain for the entire feeding period was 1.32 lbs. The average dry feed intake was 14.21 lbs/day. The average efficiency was 10.76 lbs. of dry feed per pound of gain. Further examination of these data illustrates the effects of temperature on rate of gain, feed efficiency and cost per pound of gain.

Feedlot cost for the period was as follows (Table 8).

Table 8.

Feedlot Costs	Per Head	Per lb.
Feed	68.81	0.2927@2.720 $ Per Dry CWT
Non-Feed	26.70	0.1136@0.150 $ Per Day
Interest	20.01	0.0851@14.000 $ Per Yr.
Total	115.51	0.4913

Feed costs represent the majority of the production expenses. They amount to $68.81 per head or 29 cents per pound gained. The non-feed costs, which were estimated to be 15 cents per head per day, are $26.70 for the period of 11.4 cents per pound of gain. Non-feed costs are such items as labor, veterinarian, medical, death loss, fuel, etc. Interest costs were estimated at 14 percent per year. These costs amounted to $20.01 or about 8.5 cents per pound of gain. Total costs are $115.51 or 49.1 cents per pound of gain.

There is still a month of pasture costs plus some additional feed that will be required the month prior to breeding. These costs are as follows:

Pasture	= $ 6.00
Feed (3 lbs. grain/day@$0.045) (3 × .045) × 30 days	= 4.00
Non-feed costs (15 cents/day) (.15 × 30)	= 4.50
	$14.50

Total costs to produce a replacement heifer calf from weaning to breeding are estimated to be $130.01 ($115.51 + $14.50).

The total dollars required to produce a replacement heifer are now significant. Costs from conception to weaning are $309.23 and the costs from weaning to breeding are $130.01 for a total investment of $439.24.

The margin for error in properly producing replacement heifers is large. If the heifers are fed too little they will not become pregnant at the appropriate time. If they are fed in excess they will become fat, decreasing their productive life and create unnecessary production costs. Therein lies the challenge to the producer.

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