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Effects of Nutrition on Reproduction and Productivity of Replacement Heifers

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Greater emphasis on production efficiency has stimulated ranchers to look for methods of increasing the production of their herds without increasing cow numbers. Proper development of replacement heifers may be one of the best management practices for improving efficiency of a beef operation. Heifer calves which reach puberty early and conceive early in the breeding season will calve early the following year. They should produce a heavy calf at weaning and should rebreed early with the next calf. If this sequence continues each year, lifetime productivity should reach maximum level. Therefore, efficiency of production in a herd could be improved until all cows are calving early and producing at their maximum level.

Several research studies have been conducted in western South Dakota to investigate methods of developing replacement heifers and to determine the effects of nutrition on reproductive performance and lifetime productivity. This paper will give the preliminary results of these studies using the data available.

Cooperative Research Trials

Two research trials were conducted in cooperation with five ranches to study effects of three levels of nutrition the first winter on subsequent reproductive performance and lifetime productivity of replacement heifer calves. Trial 1 was initiated in the fall of 1972 with 117 Hereford heifer calves from two Harding county ranches. Trial 2 began in the fall of 1973 and involved 153 Hereford heifer calves from one Dewey county ranch and two Meade county ranches.

Procedure

Both trials were conducted similarly. The top heifer calves on each ranch were selected for replacements after weaning using production records and visual appraisal. The heifers were then moved to the Cottonwood Research Station (near Philip, S.D.) for the wintering period. They were randomly allotted within ranch, weight and age to three levels of winter nutrition (high, medium and low) to gain 1.5, 1.0 and 0.5 lb. per day, respectively. Rations used during the 150-day wintering period are shown in tables 1 and 3 for Trials 1 and 2, respectively. During the last 30 days of the wintering period, the heifers were observed for estrus and yearling pelvic measurements were taken. The heifer groups were combined after the wintering period and moved to the Ft. Meade Research Station (near Sturgis) for summer grazing and breeding. They were bred AI to either a

red or black Angus bull during a 50-day breeding season beginning about May 25. In October, all heifers were pregnancy checked and bred heifers were returned to their respective owners as herd replacements. The heifers were fed and managed as a group on each ranch to prevent influences on treatment effects. Reproductive performance and calf production of the heifers (cows) are being recorded each year to evaluate the long-term effects of first winter nutrition on developing heifers.

### Results and Discussion

Trial 1. Wintering and breeding results of Trial 1 heifers are given in table 1 for the two ranches separately. Winter gains were lower than desired for all groups but sufficient differences existed between groups so comparisons of breeding performance could be made.

Percent of heifers showing estrus by 12 months of age was significantly higher for the high level groups with little difference between the medium and low level groups. The high level groups also showed a higher conception rate during the first 21 days of breeding (60 and 50%) than the low level groups (20 and 33%). This indicates heifers fed at a high level of nutrition the first winter have an earlier onset of estrus and conceive earlier in the breeding season.

The 50-day conception results were different for the two ranches. Ranch A heifers showed the highest percent conception in the high level group (87%) and a decrease in conception as the nutrition level decreased. This response is consistent with reports from other research stations. Ranch B heifers responded differently with the medium level group having the highest conception rate (79%). Conception rates were 75% and 63% for the low level and high level, respectively. Because results differed between ranches, additional research trials were warranted.

Average conception date was 7 to 11 days earlier for both high level groups which reflects earlier breeding. A statistical analysis of the data showed winter rate of gain was the most important factor influencing date of conception. This means that heifers should be fed well during the wintering period to conceive early in the breeding season. Heifers that were roughed through the winter gained rapidly on summer pastures but conceived later in the breeding season.

Results of the first calf crop from the two ranches indicated only slight differences between the nutrition groups in weight before calving (table 2). Average calving date was earlier for the high groups. Calf birth weight tended to be smaller for the low groups but greater calf death loss was experienced at birth and during the first week. Calving difficulty scores showed no trend among the groups. Analysis of the data indicated that calving difficulty was influenced by the combination of calf birth weight and the cow's internal pelvic area.

The most significant result in table 2 is the higher percent calves weaned on basis of cows exposed for the high group (73%) in Ranch A compared to the medium (53%) and the low group (40%). In Ranch B, the medium group had the highest percent calves weaned (75%). Total calf production of each group showed a 2,463 lb. advantage in Ranch A for the high group over the low group. In Ranch B, the medium group weaned 1,773 lb. more calf than the low group. These results indicate proper nutrition and development of replacement heifers will increase calf production.

Trial 2. Heifer wintering and breeding results in Trial 2 are shown in table 3. Results were similar for the three ranches so data were combined in this table. Winter gains were lower than desired and averaged about 1, 3/4 and 1/2 lb. per day respectively, for the high, medium and low nutrition heifers. A larger percent of the high level group exhibited estrus at 12 and 15 months of age than the other groups. The high level group also showed a higher percent conception during the first 21 days and during the entire 50-day breeding season. In this group, 55% conceived during the first 21 days with 90% conception during the season. Only 55% of the medium level and 63% of the low level heifers conceived during the breeding season. Average conception date for the high level group was 7 and 8 days earlier than the other groups. These findings support the results of Ranch A in Trial 1 and confirm that the high winter nutrition level tends to increase total conception rate as well as influence date of conception.

Table 4 shows the first calf crop results of Trial 2 heifers. Calving date was earlier for the high group and calf birth weight was slightly larger; however, more calf loss was experienced in the medium and low groups. Calving difficulty appeared to be influenced by cow pelvic area as well as calf birth weight.

Since weaning data are not available at this writing, the projected percent calf crop weaned is given. High level cows show a potential 84% calf crop compared to 49% for the medium and 55% for the low groups. These results are consistent with Trial 1 - Ranch A results and suggest greater production can be obtained by proper heifer development.

#### Antelope Research Station Trial

A heifer development trial was incorporated into a long-term crossbreeding and management research project initiated at the Antelope Station in the fall of 1972. Two levels of winter nutrition on replacement heifer calves of two different breed types were compared.

#### Procedure

Fifty Hereford and 48 Simmental-Hereford first cross heifers were randomly allotted within breed, weight and age to a regular or super management regime. The regular group received a full feed of hay (1/3 alfalfa - 2/3 grass) plus 1.5 lb. of (12% protein) barley cake per head daily. The super group was fed the same kind of hay free choice plus 4 lb. barley cake per day. Both groups were in drylot during this trial. A 30-day AI breeding season began on June 4 using semen from one polled Hereford bull after which the heifers were moved to pasture and exposed to two Angus bulls for 20 days.

Heifers remained on native pasture as one group during the summer and fall but were divided into the same management groups for the second winter feeding on pasture. The regular group was fed 2 lb. of 20% protein cake per day while the super group received 5 lb. alfalfa hay daily. Both groups received grass hay during the late winter period and after calving. The super group was given a flush of 4 lb. barley cake per head per day 30 days prebreeding through 20 days of the breeding season while on pasture. The second breeding season was 60 days with 30 days AI and 30 days clean-up bulls. Cows were pregnancy checked each fall in October.

## Results and Discussion

Wintering and breeding results of the Antelope trial are shown in table 5. All groups gained well during the wintering period with adequate differences between groups in winter gain and weight before breeding to determine influences on breeding performance. For the Hereford heifers, the super group had a higher percent showing estrus and conceiving during the first 21 days. During the entire breeding season, 92% of the super heifers conceived compared to 72% of the regular heifers. This indicates the Hereford heifers under these management conditions had to gain over 1 lb. per day during the winter to conceive at a satisfactory level.

The Simmental-Hereford crossbred heifers showed little difference between groups in percent exhibiting estrus or conceiving during the breeding season. Average conception date varied only slightly among all groups.

Little difference in weight before calving, calving date or calf birth weight between the two Hereford groups was observed (table 6). The regular Hereford heifers had smaller pelvic areas, more calving difficulty and greater calf death loss than the super group. The super crossbreds had heavier calves at birth, larger pelvic areas and fewer calf losses than the regular crossbreds. Percent calf crop weaned and total calf production were higher in the super or high nutrition groups. Rebreeding performance of the super groups was lower than the regular groups. More research is being conducted in this area to determine why this response was obtained.

### Cottonwood Research Station Trial

A trial on heifer development was conducted at the Cottonwood Station beginning in the fall of 1974. This trial was part of a long-term crossbreeding and nutrition project and compared two crossbred heifer groups on two levels of winter nutrition.

#### Procedure

Ninety Hereford-Angus and 88 Simmental-Angus first cross heifer calves were randomly allotted within breed, weight and age to a regular or high level nutrition group. The regular group was on winter pasture and fed approximately 5 lb. alfalfa and 4 lb. grain (mixture oats and corn) per head daily during the 155-day wintering period. The high group was in drylot and fed a full feed of hay (1/2 alfalfa and 1/2 grass) plus 6 lb. of grain per head daily. During the last 21 days of the wintering period, sterile heat-detector bulls were placed with the heifers to help in determining percent showing estrus. Internal pelvic measurements were taken on the heifers as yearlings.

After the wintering period, the groups were combined and moved to the Ft. Meade research unit for summer grazing and breeding. A 53-day AI breeding season began on May 19 using semen from one black Angus bull. The heifers will be pregnancy checked in October.

## Results

Preliminary results of the Cottonwood trial are given in table 7. Winter gains for the regular groups were 1/2 to 2/3 lb. per day while the high groups gained 1 to 1.25 lb. daily. The spread in weight between groups before breeding was less than at the end of the wintering period because the high groups lost weight during this interval while the regular groups gained weight. The high groups had a higher percent showing estrus at 12 and 15 months of age. Also, a higher percent of the high level heifers were inseminated during the first 21 days of breeding. No conception data are available at this writing; however, these results plus the calving and production data will be obtained and the results will be forthcoming.

## SUMMARY

Four heifer development trials were conducted in western South Dakota from 1972 to 1975 involving 546 replacement heifer calves. The trials were designed to investigate the effects of different levels of first winter nutrition on subsequent breeding performance and total calf production. Heifers of four breed types were studied: Hereford, Simmental-Hereford, Simmental-Angus and Hereford-Angus. This report gives the progress of these trials.

Heifers fed at a high nutrition level the first winter exhibited estrus earlier, conceived earlier in the breeding season and had a higher conception rate than heifers fed at lower levels. These results point out that proper winter nutrition for heifer calves is very important for maximum reproductive performance.

Calving records from the Hereford and Simmental-Hereford heifers showed a slight trend for smaller calf birth weights in the low nutrition groups but greater calf death loss was experienced. Calving difficulty appeared to be influenced by calf birth weight and cow pelvic opening. Calf crop weaned per cow exposed was higher for the high level groups and was reflected in greater total pounds of calf produced.

These results indicate more income can be realized from two-year-old cows if developed properly. Also, greater production efficiency can be attained in a beef herd by proper development of replacement heifers.

Considerations for determining proper winter nutrition level for heifer calves should include: breed, age, weight and condition of the heifer at weaning. These research results suggest heifer calves born during March and April and weighing 400 to 450 lb. at weaning in average condition should be fed to gain at the following rates for high performance: Herefords - 1.2 to 1.4 lb/day; Simmental-Hereford crosses - about 1.5 lb/day; Simmental-Angus and Hereford-Angus crosses - 1 to 1.3 lb/day. Heifers that are older, heavier or in higher condition at weaning can be fed to gain at a lower rate. Ranchers must exercise judgment in selecting the proper nutrition level for their specific heifers, their available feeds and the current economic conditions.

Table 1. Trial 1- Wintering and Breeding Results of Replacement Heifers - 1973

Item	Ranch A			Ranch B		
	Winter nutrition level			Winter nutrition level		
	H	M	L	H	M	L
No. heifers	15	15	15	24	24	24
Beginning wt, lb (12/05/72)	437	437	437	443	443	443
Feed ration <sup>a</sup> , per hd daily						
Hay <sup>b</sup> , lb	10.1	10.3	11.9	10.1	10.3	11.9
Grain <sup>c</sup> , lb	6.8	3.4	1.2	6.8	3.4	1.2
Protein supplement <sup>d</sup> , lb	1.0	1.0	0.5	1.0	1.0	0.5
Winter gain, (lb/day)	1.3	0.7	0.4	1.4	0.8	0.5
Wt. before breeding, lb (5/24)	658	604	564	670	621	583
Age before breeding, days (5/24)	406	406	406	411	411	411
% showing estrus by 12 months	66.7	6.7	0	54.2	8.3	8.3
% showing estrus by 15 months	100.0	80.0	73.3	91.7	87.5	91.7
% settled first 21 days	60.0	13.3	20.0	50.0	41.7	33.3
% settled in 50-day period	86.7	66.7	53.3	62.5	79.2	75.0
Avg. conception date, (day of year)	165	175	176	164	171	172
Wt. in fall, lb (10/11/73)	830	803	781	843	812	778

<sup>a</sup> Ration amounts for the 150-day feeding period were the same for both ranches since heifers were fed together. High level group in drylot, medium and low level groups on winter pasture. Salt and mineral fed free choice.

<sup>b</sup> Mixture of 30% alfalfa and 70% native grass hay.

<sup>c</sup> Mixture of 1/3 whole oats and 2/3 rolled corn.

<sup>d</sup> 40% natural protein fed last 60 days of period.

Table 2. Trial 1 - First Calf Crop Results - 1974

Item	Ranch A			Ranch B		
	First winter nutrition level			First winter nutrition level		
	H	M	L	H	M	L
No. heifers calving	13	10	8	15	19	18
Wt. before calving, lb. (2/21/74)	956	942	933	942	926	880
Calving date, (day of year)	82	92	91	84	89	91
Calf birth wt, lb	79	80	78	80	82	76
Calf losses first week, (%)	15	20	25	7	0	17
Calving difficulty score <sup>a</sup>	2.3	2.6	1.4	2.1	2.6	2.8
Yearling internal pelvic area, cm <sup>2</sup>	148	142	149	150	142	140
Calves weaned <sup>b</sup> , (%)	73	53	40	58	75	63
Act. weaning wt <sup>c</sup> , lb	471	438	453	478	466	441
Adj. weaning wt <sup>d</sup> , lb	465	458	462	477	476	453
Total calf prod., lb	5181	3504	2718	6692	8388	6615
Fall cow wt <sup>e</sup> , lb (10/22/74)	964	994	942	979	961	927
Cows pregnant <sup>f</sup> , (%)	92	90	100	93	84	89

<sup>a</sup> Scoring system: 1 - No difficulty, 2 - Slight, 3 - Moderate, 4 - Major, 5 - Caesarean.

<sup>b</sup> Percent calculated using number of calves weaned per cow exposed to breeding.

<sup>c</sup> Calves were creep fed for 14 weeks and consumed about 240 lbs. of grain per head.

<sup>d</sup> Weaning weight adjusted to 205 days of age and to steer basis.

<sup>e</sup> Includes only cows that weaned a calf.

<sup>f</sup> Pregnancy checked in October. Breeding season began about June 10 and lasted 70 days on Ranch A and 55 days on Ranch B.



Table 3. Trial 2 - Wintering and Breeding Results of Replacement Heifers from Three Ranches - 1974

Item	Winter nutrition level		
	High	Medium	Low
No. heifers	51	51	51
Beginning wt, (12/04/73)	418	418	418
Feed ration, <sup>a</sup> per hd daily			
Alfalfa hay, lb	4.9	5.6	4.1
Grass hay, lb	5.7	6.7	3.2
Grain, <sup>b</sup> lb	6.2	3.7	0.8
Winter gain, (lb/day)	1.10	0.80	0.55
Wt. before breeding, lb (5/17)	587	555	532
Age before breeding, days (5/17)	417	417	417
% showing estrus by 12 months	25.5	11.8	13.7
% showing estrus by 15 months	96.1	72.5	76.5
% settled first 21 days	54.9	19.6	17.6
% settled in 50-day period	90.2	54.9	62.7
Avg. conception date, (day of year)	161	168	169
Wt. in fall, lb (10/15/74)	818	802	796

<sup>a</sup> High and medium level groups in drylot and low level group on winter pasture during the 150-day feeding period. Salt and mineral fed free choice to all groups.

<sup>b</sup> Mixture of 60% whole oats and 40% rolled corn.

Table 4. Trial 2 - First Calf Crop Results from Three Ranches - 1975

Item	First winter nutrition level		
	High	Medium	Low
No. heifers calving	46	28	32
Wt. before calving, lb (2/10/75)	822	817	802
Calving date, (day of year)	78.3	83.2	85.8
Calf birth wt, lb	71.0	69.0	69.1
Calf losses first week, (%)	6.5	10.7	12.5
Calving difficulty score <sup>a</sup>	2.0	1.6	2.0
Yearling internal pelvic area, cm <sup>2</sup>	146	145	138
Potential calves weaned <sup>b</sup> , (%)	84	49	55

<sup>a</sup> Scoring system: 1 - No difficulty, 2 - Slight, 3 - Moderate, 4 - Major  
5 - Caesarean.

<sup>b</sup> Weaning data not available. Percent calculated on number of calves alive  
after first week and number of cows exposed to breeding.

Table 5. Antelope Station Trial - Wintering and Breeding Results - 1973

Item	Breed and nutrition level			
	Hereford		Sim x Here	
	Regular	Super	Regular	Super
No. heifers	25	24	25	24
Beginning wt, lb (12/21/72)	420	417	438	435
Winter gain, (lb/day)	0.96	1.42	1.25	1.72
Wt. before breeding, lb (6/08)	582	642	658	716
Age before breeding, days (6/08)	424	423	415	414
% showing estrus by 15 months	80	92	96	100
% settled first 21 days	52	71	80	71
% settled in 50-day period	72	92	96	100
Avg. conception date, (day of year)	169	170	170	172
Wt. in fall, lb (October)	689	743	767	817

Table 6. Antelope Station Trial - First Calf Crop Results - 1974

Item	Breed and nutrition level			
	Hereford		Sim X Here	
	Regular	Super	Regular	Super
No. cows calving	18	22	24	24
Wt. before calving, lb (3/04/74)	828	847	914	926
Calving date, (day of year)	89	88	90	93
Calf birth wt, lb	70	70	77	82
Calf losses first week, (%)	11.1	4.5	12.5	4.2
Calving difficulty score <sup>a</sup>	2.4	1.7	1.5	1.7
Yearling internal pelvic area, cm <sup>2</sup>	144	149	160	166
Calves weaned <sup>b</sup> , (%)	64	88	80	96
Act. weaning wt, lb	381	362	434	435
Adj. weaning wt <sup>c</sup> , lb	388	370	447	451
Total calf prod., lb	6096	7602	8680	10005
Cows pregnant <sup>d</sup> , (%)	89	64	71	63

<sup>a</sup> Scoring system: 1 - No difficulty, 2 - Slight, 3 - Moderate, 4 - Major  
5 - Caesarean.

<sup>b</sup> Percent calculated using number of calves weaned per cow exposed to breeding.

<sup>c</sup> Weaning weight adjusted to 205 days of age and to steer basis.

<sup>d</sup> Pregnancy checked in October. Breeding season began on June 1 and lasted 60 days.

Table 7. Cottonwood Station Trial - Wintering and Breeding Results - 1975

Item	Breed and nutrition level			
	Here X Angus		Sim X Angus	
	Regular	High	Regular	High
No. heifers	45	45	44	44
Beginning wt, lb (11/25/74)	444	444	473	471
Winter gain, (lb/day)	0.52	0.97	0.67	1.25
Wt. before breeding, lb (5/19)	539	568	592	633
Age before breeding, days (5/19)	414	414	406	406
Yearling internal pelvic area, cm <sup>2</sup>	144	143	151	153
% showing estrus by 12 months	9	16	21	34
% showing estrus by 15 months	98	98	96	100
% inseminated first 21 days	49	62	59	68
% inseminated in 53-day period	98	98	96	100