enotypes as predicted by the x-ray fits so closely the expected distribu-ion of genotypes in the lines with known dwarfism history. However, he occurrence of calves which must be predicted carrier on the basis of heir x-ray in lines believed to be clean indicates that more study is ieeded.

The results obtained in this study to date are too inclusive to justify . critical evaluation of the technique at this time. Although it is ap-parent that occasionally an erroneous diagnosis is made, it may well ɔe that the technique may prove accurate enough to be of real value n problem herds. Certainly further study to attempt to determine the iccuracy of the test is justified, and is under way at the present time. Recommendation as to the possible use of this technique by breeders :annot be made until further information has been obtained.

Summary

Data are presented on two years study of a technique for detecting beef calves that are carriers of the snorter dwarf gene, based on abnormalities observed in radiographs of the lumbar vertebrate of very young calves. Snorter dwarf calves have very characteristic abnormalities which have never been observed in x-rays of non-dwarf calves. Lumbar x-rays accurately identify a dwarf calf, and may be very useful to breeders in determining the dwarfism status of a doubtful calf.

The accuracy of the method as a means of detecting carriers of the dwarf gene could not be determined from the limited number of animals of known genotype included in the study. However, the results obtained to date are promising enough to justify further study.

Effect of Feeding Different Levels of Winter Supplement and Age of First Calving on the Performance of Range Beef Cows and Replacement Heifers

J. E. ZIMMERMAN, L. S. POPE, DWIGHT STEPHENS and GEORGE WALLER

The most common system of cow herd management in the southwest is to graze year-long and supplement during the winter to make up for the lack of protein, phosphorus or carotene in the weathered range forage. Previous tests have shown that this is the most economical and profitable method of maintaining brood cows, particularly under a spring calving program.

However, the question often raised is: How much supplemental feed should a cow receive during the winter months? Obviously, this may depend on several factors such as calving date or length of the lactation period before spring grass appears, the type and amount of native grass available, and the protein content of the supplement fed. Since supplemental feed during the winter represents the largest out-

of-pocket cost in a cow-calf operation, it is necessary to study the effect of feeding different amounts or levels to cows wintering on native grass. It is particularly desirable to conduct long-time studies in which the accumulative effect of high or low levels of supplemental feed may express themselves.

In the fall of 1948, a long-time experiment was initiated at this station with 90 weanling Hereford heifer calves. These calves were started on feed in October, 1948, and in the design of the project were to be wintered at three levels of supplemental feed each year throughout their productive life. In addition, one-half of the heifers within each level of wintering were bred as yearlings and calved first as two-year-olds; their mates were first exposed as two-year-olds and calved first as three's. In this way the effect of different levels of supplemental winter feed and age at first calving on life-time performance could be studied. This report gives the results of the eighth year (1955-56) of the project and contains a summary of all results obtained to the fall of 1956.

During the experiment, it has become apparent that more carefully controlled studies are necessary to evaluate the effects of different levels of supplemental winter feed, particularly on the growing and developing heifer. Further, it is desirable to repeat range trials several years in order to minimize the variation in climate and range conditions occurring from year to year. Thus, in the fall of 1954 a series of repetitions was initiated with weanling heifer calves from the experiment station herd. The majority of these calves were from the original cows used in the experiment. From the records available, it was possible to allot the calves according to age, sire, dam's average productivity, body weight, and grade. The heifers used in the first repetition are now calving for the second time (spring of 1957) and since data on this calf crop is incomplete, the results through the first 1½ years of the project (including the first calf crop) are summarized in this report.

In the fall of 1955, and again in 1956, two further repetitions of the experimental treatments were started, again using heifers from the experiment station herd. Results obtained up to March 5, 1957, including the calving performance of the majority of the heifers, are given in this report.

I. Studies with Mature Cows Wintered at Different Levels.

In the fall of 1948, six lots of 15 heifer calves each were placed on experiment at the Lake Carl Blackwell range west of Stillwater. In the summer of 1949 they were moved to the Fort Reno station and the study has continued at this location since that time. The cattle were grazed year-long on native grass consisting mostly of big and little bluestem, Indian, switch, side oats grama and less desirable annual grasses. The cows were given sufficient pasture to assure an ample amount of grass throughout the year. A stocking rate of approximately eight acres per cow has been maintained. The cows grazed together during the summer, and were divided into their respective groups

about November 1, each year to receive their respective levels of winter supplement (November to mid-April). They were rotated among the native grass pastures during the winter at monthly intervals to minimize pasture differences.

The winter supplement was fed on alternate days, twice the daily allowance at each feeding. A mineral mix of 2 parts salt and 1 part steamed bone meal, free choice, was available to the cows in all lots throughout the test. The average daily supplements fed per head each winter since 1948 follows:

Low Level (Lots 1 and 2)—1 lb. cottonseed meal pellets
Medium Level (Lots 3 and 4)—2½ lbs. cottonseed meal pellets.
High Level (Lots 5 and 6)—2½ lbs. cottonseed meal pellets + 3 lbs. of oats.

In establishing these levels, consideration was given to the prevailing practices of many ranchers in the state, and to the available information on the requirements of beef cows. It was believed that the low level would supply about two-thirds of the digestible protein needed by range beef cows; whereas, the high level would not only supply ample protein but additional energy. One-half of the heifers in each nutritional treatment (Lots 1, 3 and 5) were pasture bred during the early summer of 1949 and dropped their first calves as two-year-olds in the spring of 1950. Their mates (Lots 2, 4 and 6) were pasture bred for the first time as two-year-olds in the summer of 1950 and calved first in the spring of 1951.

To date, the original cows have been subjected to their respective winter treatments for nine consecutive years. Data obtained includes the seventh and eighth calf crops, depending on age at first calving. Since the data for the winter of 1956-57 is incomplete, this report deals with cow performance during the 1955-56 season, and will summarize the results obtained up to the fall of 1956 (first eight years on test).*

Results of the 1955-56 Test

The results of the 1955-56 test with the original cows are shown in Table 1, and a summary of the results obtained up to the fall of 1956 are given in Table 2.

The difference in winter weight loss, considering only the cows which calved, was surprisingly small in view of the differences in amount of supplemental feed consumed. This has been the tendency since the cows reached maturity (last five winters) and is in contrast to the rather severe weight losses suffered by the low level heifers when they calved for the first or second times during the winters of 1949-50 and 1950-51.

Winter gain up to calving following a rather definite trend proportional to the level of supplement fed. From calving to mid-April, body weight losses followed an inconsistent pattern. It has been a consistent

* Detailed data for other years may be found in Okla. Agr. Expt. Sta. Misc. Publ. MP-19, -22-27-31-34-43-45 (1948-56).

Table 1.—Weight Data, Feed Costs, and Calf Production Records for Cows Wintered at Low, Medium and High Levels of Supplemental Feed (1955-56).

Age at first calving	2-Year-Olds			3-Year-Olds		
Lot Number	1	3	5	2	4	6
Level of Supplement fed	Low	Med.	High	Low	Med.	High
Winter Phase (167 days)						
No. of cows/lot 1955[1]	14	14	10	14	13	13
Average cow weights (lbs.)						
Fall 11/4/55	1144	1190	1240	1225	1220	1263
Gain to calving 2/16/56[2]	— 8	+39	+60	— 5	+53	+65
Loss from calving to 4/20/56[3]	—139	—171	—148	—101	—193	—163
Spring weight 4/20/56	1025	1081	1152	1135	1069[4]	1191
Cost of winter feed/cow ($)	10.39	17.87	28.75	10.39	17.87	28.75
Summer Phase (193 days)						
Average cow weights (lbs.)						
Spring 4/20/56	1025	1081	1152	1135	1069	1191
Fall 10/30/56	1103	1165	1165	1182	1128	1223
Summer gain	78	84	13	47	59	32
Summer feed cost/cow ($)	17.79	17.79	17.79	17.79	17.79	17.79
Total yearly feed cost/cow ($)	28.28	35.66	46.54	28.28	35.66	46.54
Calf Production Records						
No. of calves born	14	13	10	13	13	13
No. of calves weaned[5]	12	12	10	13	12	12
Average calving date	3/22	3/24	3/26	4/1	3/15	3/21
Average calf weights (lbs.)						
At birth (corrected for sex)	78	76	82	81	82	81
At weaning (corrected for age and sex)	510	499	510	515	506	515

[1] The project was initiated in the fall of 1948 with 15 heifers per lot. As of November, 1955, a total of 12 cows had been removed.

[2] Includes only those cows which had not calved by February 16.

[3] Includes only those cows which had calved before April 20.

[4] One cow was removed from Lot 4 during the winter because of an infection that developed at calving time.

[5] Two calves in Lot 1 and one calf in Lot 4 died at calving; one cow in each of lots 2, 3 and 6 did not calve; one calf in Lot 3 died at two months of age of unknown causes; and one calf in Lot 6 died at two weeks of age of an infection.

observation in these studies that the low-level cows are much better "rustlers" and spend more time grazing than cows receiving more supplemental feed. Winter feed costs were approximately 72 percent higher for the medium fed groups, and 177 percent higher for the high level lots than for those cows wintered at the low level.

Summer weight gains were inconsistent among the lots, and were much smaller than observed in previous years. Among the factors responsible may have been an extreme drouth during the summer of 1956, a severe overnight shrink at the time the fall weights were recorded, and the advancing age of the cows. Since pasture costs were the same for all lots, the total yearly feed cost varied directly with the cost of supplemental winter feed.

Little difference was noted in number of calves born, number weaned, birth weights and weaning weights of the calves. Calving dates were somewhat later for all lots than observed in previous years due to a hand-mating system used in the spring of 1955 to obtain more accurate sire information. Considerable difficulty was encountered in getting the cows settled under this hand-mating program.

In Table 2, data obtained up to the fall of 1956 (first eight years of the test) are presented. In regard to body weight, it will be noted that Lot 1 cows were lightest in body weight while those in Lot 6 were heaviest. Cows calving first as two-year-olds were about 50 lbs. lighter on the average than those which calved first as three's. From body measurements taken during the experiment, it was noted that the lower fed heifers and those calving first as two's, took slightly longer to reach their mature body size. Average winter weight losses during the course of the experiment have been slightly greater for the low-level lots (1 and 2), and least for the high-level lots (5 and 6). Average summer gains have been in reverse order in respect to winter weight gains.

Table 2.—Summary of 8½ Years' Results in Long-Time Study with Beef Cows Wintered at Different Levels (1948-56).

Age at first calving	2-Year-Olds			3-Year-Olds		
Lot number	1	3	5	2	4	6
Level of supplement fed	Low	Med.	High	Low	Med.	High
No. of cows at start of experiment	15	15	15	15	15	15
No. remaining on test Nov. 1956	14	14	10	14	12	13
Ave. Wt. changes of cows on test (lbs.)						
Initial wt. 10/29/48	473	471	476	476	461	470
Ave. Winter weight loss	—108	— 98	— 63	—112	— 97	— 67
Ave. summer gain	188	185	147	198	179	160
Final wt. 10/30/56	1103	1165	1165	1182	1128	1223
Calf production records at 8½ yrs. of age						
Heifers assisted at first calving	6	8	4	--	--	1
Calves lost at first calving	1	1	2	--	--	2
Total no. of calves weaned	91	93	75	82	71	73
% calf crop weaned[1]	93	95	89	97	89	90
Total number of calves weaned/cow	6.44	6.58	6.03	5.79	5.13	5.15
Ave. calving date	3/14	3/9	3/8	3/15	3/4	3/5
Average calf weights (lbs.)						
At birth (sex corrected)	76	76	77	76	76	78
At weaning (age & sex corrected)	480	472	471	495	474	492
Total feed pasture and mineral cost/cow ($)	224.18	299.66	402.54	224.18	299.66	402.54
Cow cost per cwt. calf weaned ($)	7.26	9.65	14.16	7.83	12.31	15.87

[1] Based on number of cows bred to calve each year. Calf losses not due to experimental treatment were not charged against the lot.

Total calf production based on the number of cows bred to calve each year varied slightly. Within each "age at first calving" group, there is no indication that the low levels of winter supplementation, as practiced in this experiment, were deterimental. On the other hand, the high levels of supplemental feed have not been beneficial.

There have been no consistent differences in birth weights (corrected for sex) or weaning weights (corrected for both age and sex) among the groups. The difficulty at first calving with the two-year-old heifers is apparent from the data contained in Table 2. The average calving date for the low level cows has been about one week later than for the high level lots. This difference was somewhat greater for the early years of the project, and has become less since the cows reached maturity.

Total feed, pasture and mineral costs per cow have been 34 percent greater for the medium level and 80 percent greater for the high level as compared to the low level of supplemental feed. Cost per cwt. of calf produced has varied directly with the cow costs, since there has been no significant difference in productivity.

A comparison of the performance of cows bred to calve first as two-year-olds versus those calving first as three's can be found in Table 3. Here the results from 30 additional cows, which were purchased with the original group, were included. These cows were wintered on the medium level and used to test the effect of feeding different supplements during the summer. In general, no significant effect from previous treatment has been noted, hence they are considered in this comparison. The results indicate that cows bred to calve first as two-year-olds may experience more difficulty at first calving (50 percent of the heifers had to be assisted at first calving). The average weaning weight per calf is somewhat lighter due to the small size of first calves by two-year-olds. However, their total lifetime performance, considering possible number of calvings, has shown that they have weaned 1.1

Table 3.—Production Records at 8½ Years for Cows that Calved First as Two- and Three-year-olds.

Age at first calving	Two-Year-Olds	Three-Year-Olds
Number of cows compared	60	60
Number of possible calvings[1]	384	338
Number of calves weaned	350	298
% calf crop weaned	91.1	88.2
Number of calves weaned per cow	6.4	5.3
Ave. weaning wts. lbs. (corrected for age & sex)	477	487
Cow cost/cwt. calf weaned ($)	10.02	11.73

[1] Considers the total number of times the cows should have calved. Per cent calf crop is based on this figure.

more calf per cow than those calving first as three-year-olds. Cow cost per cwt. of calf weaned has been reduced accordingly.

II. Results of the Second Trial (1954-1956)

A repetition of the original project was initiated in October, 1954, with 42 heifers from the experimental herd, divided equally into 3 heifers gained only about two-thirds as much as the medium and low lots of 14 head each. The heifers were allotted on the basis of shrunk weight, age, sire, and productivity of dam, with one lot wintered at each of the low, medium and high levels. In addition, the stocking rate was restricted so that the heifers received only 3.5 acres of grass per head on a year-long basis, as compared to more than 8 acres per head in the original project.

A summary of weight changes up to November, 1956, and production records for the first calf crop are given in Table 4. In addition

Table 4.—Summary of Performance of Beef Heifers Wintered at Low, Medium and High Levels of Supplemental Feed (1954-56).

Lot Number Level of supplement fed	1 Low	2 Med.	3 High
No. of heifers/lot 10/29/54	14	14	14
No. of heifers remaining/lot 11/2/56[1]	12	14	14
Average weights (lbs.)			
Initial 10/29/54	495	493	493
Winter gain to 4/11/55	52	95	153
Summer gain 4/11 to 11/4/55	316	312	290
Winter gain 11/4/55 to 4/17/56	—108	—80	— 6
Summer gain 4/17 to 11/2/56	162	174	110
Final wt. 11/2/56	922	994	1040
Total feed, pasture and mineral cost/cow ($) 10/29/54 to 11/2/56	49.30	67.10	89.40
Calf production records			
No. of calves born	12	13	14
No. of calves weaned[2]	11	11	10
Ave. calving date	3/3	2/24	2/18
No. of heifers requiring assistance	5	8	9
Ave. difficulty at calving score[3]	2.1	2.8	3.3
Ave. calf weights (lbs.)			
At birth (corrected for sex)	67	75	75
At weaning (corrected for age and sex)	396	416	442
Cost per cwt. of calf produced ($)	12.45	16.13	20.23

[1] One heifer became sick in early December, 1954, and was removed from test. One heifer failed to breed as a yearling and was removed in November, 1956, after a pregnancy examination showed her to be open again.

[2] One calf in Lot 1 died soon after birth of unknown causes; one calf in Lot 2 and one calf in Lot 3 died after a very difficult delivery; one calf in Lot 2 was found dead in the pasture at one week of age, and 3 heifers in Lot 3 produced premature calves which were dead at birth.

[3] A numerical score was used to evaluate difficulty at calving. A score of 1 indicates cow calved normally without assistance, and 7 indicates extreme difficulty in which both cow and calf were lost.

to these records, detailed measurements of body growth from photographs and actual body measurements have been taken periodically.

During the winter of 1954-55 as calves, the heifers of Lot 1 gained .32 lbs. per day, while those of Lot 2 gained .58 lbs. and Lot 3 gained .93 lbs. Heifers of all lots made excellent gains during the summer of 1955, with a tendency for those heifers with smaller winter gains to make slightly greater summer gains. Weight losses for the second winter as bred yearlings were greatest for Lot 1, although losses for all lots were somewhat smaller than might have been expected. Gains during the summer of 1956 were rather inconsistent, although Lot 3 heifers gained only about two-thirds as much as the medium and low level groups. These gains were somewhat smaller than the gains produced by similar heifers in previous summers, and may be attributed partly to the extreme drouth and partly to the good condition of the heifers at the start of the summer grazing period.

At the end of the summer grazing period, there was only 118 lbs. difference in body weight between the high and low levels of wintering and 72 lbs. difference between the low and medium groups. Body measurements taken at the end of the summer (November, 1956) indicated that level of wintering had very little, if any, effect on height and length of body. Depth of body, heart girth and width measurements were affected slightly. There was a noticeable difference in the condition of the heifers with Lot 3 heifers in very fleshy condition.

There was no significant difference between the lots in number of calves produced, although the low level heifers weaned the highest percentage calf crop and the high level the smallest percent. Four heifers produced premature calves which were dead at birth. No reason for this high abortion rate is apparent. The heifers were all vaccinated for contagious abortion at about 8 months of age, and have tested clean. Three of the heifers which aborted were on the high level and one was on the low level.

Considerable calving difficulty was experienced in all lots, as might be expected with two-year-old heifers. Difficulty of calving was least for the low level lot, due apparently to the lighter birth weight of their calves and the fleshier condition of the heifers of Lots 2 and 3. Considering all heifers that calved, an average of 56% had to be assisted, although in certain instances it is possible that the heifers could have calved without help. Records obtained at this station on a large number of two-year-old heifers calving in both a commercial herd and at Lake Blackwell experimental range, indicate that the results obtained in the current test were very favorable. Losses running as high as 15 percent of the calves and 5 percent of the heifers have been experienced in calving two-year-old heifers less well developed than the ones used in this study.

Weaning weights of the calves were directly related to the level of supplemental feed, with the calves from the medium level lot averaging 20 lbs. heavier, and those from the high level lot 46 lbs. heavier

than the calves from the low level lot. However, the feed costs were considerably less for the low level of supplemental feed. Cost per cwt. of calf produced was 30% greater for the medium level lot and 62% greater for the high level lot than for the low level lot.

III. Results of the Third Trial (1955-57)

A third repetition was initiated in October, 1955, with 3 lots of 14 heifers each from the station herd. Allotment and management of these heifers was the same as for the second trial, with the exception that the level of supplemental feed was varied in an attempt to attain the following gain from early November to mid-April:

First winter as calves:

Low level—fed to make no gain during the winter period.
Medium level—fed to gain ½ lb. per day.
High level—fed to gain 1 lb. or more per day.

Second winter as bred yearlings:

Low level—no gain to calving, marked loss of body weight after calving to total approximately 250 lbs. loss from fall to spring.
Medium level—moderate gain to calving (50 lbs.) with approximately 150 lbs. loss from calving to the end of the winter period.
High level—high gain to calving (100 lbs.) with essentially no loss while nursing calves.

A summary of weight changes from November 1, 1955 to February 4, 1957, and production records for all heifers that had calved by March 5, 1957 are given in Table 5.

During the winter of 1955-56, as calves, Lot 1 heifers gained 21 lbs. more than was intended. This gain was achieved with an average of only .42 lbs. of cottonseed meal per head daily. During the second winter (1956-57) they had lost only 7 lbs. per head to February 4 and had received no supplemental feed. Lot 2 heifers gained .47 lbs. per day on 1.85 lbs. of cottonseed meal during the winter of 1955-56 and gained 37 pounds from November 2 to February 4 of the second winter. They received approximately 2 lbs. of cottonseed meal per day during the second winter of the test. Lot 3 heifers gained .93 lb. per day during the 1955-56 winter and had gained 80 lb. to February 4 of the second winter. They received 2.05 lb. of cottonseed meal and 3.33 lbs. of milo per head daily during the 1955-56 winter as calves and approximately 2.5 lbs. of cottonseed meal and 4 lbs. of milo per head daily during the 1956-57 winter. Summer gains were satisfactory for all lots with the low-level lot making the greatest gain and the high-level lot the least.

An analysis of body measurements taken in November, 1956 indicates very little, if any, effect of the level of wintering on length or height. Heart girth measure was affected to the greatest extent with a tendency for the measures of body width to be slightly greater for the high-level heifers.

Table 5.—Summary of Performance of Beef Heifers Wintered at Low, Medium and High Levels of Supplemental Feed (Third Trial, 1955-57).

Lot Number Level of Supplement fed	1 Low	2 Med.	3 High
No. of heifers/lot 3/5/57	13[1]	14	14
Average weights (lbs.)			
Initial 11/1/55	506	507	506
Winter gain to 4/19/56	21	80	156
Summer gain 4/19 to 11/2/56	308	260	235
Winter gain to calving 11/2/56 to 2/4/57	—7	37	80
Final weight 2/4/57	828	886	978
Total feed, pasture and mineral cost 11/1/55 to 11/2/56	22.84	30.83	40.81
Calf production records to 3/5/57			
No. of heifers calving to 3/5/57	9	6	13
Death loss at calving			
Heifers	1	0	0
Calves	2	1	2
Number of heifers requiring assistance	8	5	11
Average difficulty at calving score[2]	3.7	3.0	3.4
Average birth weight of calves (sex corrected)	75	75	78

[1] One heifer died at calving 2/20/57.

[2] A numerical score was used to evaluate difficulty at calving. A score of 1 indicates cow calved normally without assistance, and 7 indicates extreme difficulty in which both cow and calf were lost.

From the calving data available, death loss and difficulty of calving have been somewhat greater than has been experienced in previous years with this project. The increased difficulty of calving may be due to the heavy birth weights of the calves. The average birth weight is about 5 lbs. heavier than in previous years. No reason for the heavier birth weights is apparent. No significant difference has been observed between the lots in difficulty of calving.

IV. Results of the Fourth Trial (Winter 1956-57).

A fourth trial was initiated in November, 1956 with 45 heifer calves from the experimental herd divided into 3 lots of 15 head each. Allotment was made on the basis of shrunk weight, age, dam productivity, sire, and grade. The amount of winter feed was adjusted in an attempt to attain a desired amount of gain as described for the third trial.

Low-level heifers received no feed until mid-January and then were given approximately 0.5 lb. of cottonseed meal per day. They had lost .32 lbs. per day to March 5. Heifers wintered at the medium-level gained .28 lbs. per day to March 5. They have received approximately 2 lbs. of cottonseed meal per day. High-level heifers received 2.5 lbs. of cottonseed meal and 4 lbs. of milo per day and have gained .86 lbs. per day to date.

It is planned to pasture-mate the heifers, starting May 1, 1957, so that they will calve first in 1958 as two-year-olds. Again in the winter of 1957-58 the extent of body weight gain or loss will be controlled by varying the levels of supplemental feed.

Summary

The results of the eighth consecutive year in a long-time project at the Ft. Reno station on the effects of low, medium, and high levels of supplemental feed on the performance of range beef cows are presented. Data obtained indicate a slight effect of level of winter feed on mature body weight of the cows, but no significant difference in percentage calf crop weaned or average corrected weaning weight of the calves. The cost per cwt. of calf weaned has been least for those cows wintered at the low-level, and has been less for those calving first as two-year-olds than for the cows calving first as three-year-olds. The test with the original cows is now in its ninth consecutive year.

Three repetitions are now in progress with heifers from the experimental herd. Body weight was affected somewhat in all trials by level of winter feeding; however, summer gains have tended to compensate for differences in winter gain. Weaning weights of calves from the second trial were directly proportional to the level of winter feed, but the differences in weaning weight were not great enough to pay for the extra feed cost of the medium and high levels. Calving difficulty was least for the low-level lots in the second trial, but was about equal for all lots in the third trial. In the third and fourth replications an attempt is being made to establish the total amount of winter gain of the heifers by adjustments in the amount of supplemental feed.

Mineral and Management Studies With Beef Cows In Southern Oklahoma

ROBERT TOTUSEK AND WILLIS D. GALLUP

Experiments at the Wilburton Station from 1947 to 1951 clearly demonstrated that the forage in that area is frequently deficient in phosphorus and that a phosphorus supplement must be provided for best results. For example, the feeding of 26 pounds of dicalcium phosphate per head during a period of 21 months increased the weight of heifers 166 pounds. However, the performance of reproducing cows as measured by the number of calves produced and the weaning weight of the calves was very poor even with supplemental phosphorus. Several suggestions regarding the possible causes of poor performance were (1) insufficient phosphorus intake during the summer due to a low consumption of mineral mix; (2) deficiency of trace minerals; (3) internal parasites; and (4) lack of shade during the hot summer months.

To test some of the suggested causes of reproductive failures, the present experiment was started at Wilburton in the fall of 1951. Results of the first, second, third and fourth years' work were reported in the 1953, 1954, 1955 and 1956 Feeders' Day Reports. The fifth year's work (November 1955-October 1956) is summarized here.