Name: James Mitchell Steed Date of Degree: May 28, 1967

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: RESULTS OF EIGHT YEARS OF ARTIFICIAL INSEMINATION IN A PUREBRED ANGUS HERD

Pages in Study: 29 Candidate for Degree of Master of Science

Major Field: Rural Adult Education

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Methods and Procedure: Records of 783 conceptions resulting from artificial insemination at Kermac Angus Ranch were studied to determine how breeding efficiency varied between groups of cows, by seasons of the year, by years, and by age of cows. In addition, a study was made of the influence of delaying rebreeding and a study of how a heifer's first conception could serve as an indication of her future efficiency as a breeder.

Findings and Conclusions: The 783 conceptions required an average of 2.14 services per conception and 48.43 percent of these conceptions were conceptions to first service. There was rapid improvement in services required per conception during the first four years of the study and very little improvement in the last half of the study. Rate of conception to first service showed only slight improvement after 1960. Breeding efficiency of cows in this study steadily improved through five years of age. Percentage of cows settling to first service increased to five years of age. Best results were obtained when breeding was started during the first quarter of the year. There was a steady improvement in breeding efficiency of cows born during the different years of the study. Delaying rebreeding until 90 days or more postpartum seemed to improve breeding efficiency. Heifers requiring four or more services for their first conception were poorer breeders later than heifers requiring less than four services for their first conception.

ADVISER'S APPROVAL E. J. Turman

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ADVISER'S APPROVAL E. J. Inman

RESULTS OF EIGHT YEARS OF ARTIFICIAL INSEMINATION IN A PUREBRED ANGUS HERD

By

James Mitchell Steed

Bachelor of Science

Oklahoma State University

Stillwater, Oklahoma

1939

Submitted to the faculty of the Graduate School
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RESULTS OF EIGHT YEARS OF ARTIFICIAL
INSEMINATION IN A PUREBRED
ANGUS HERD

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INTRODUCTION

The high cost of production associated with a beef cow herd makes it imperative for the cows to calve regularly in the most desirable season of the year. If the cow-calf operator is going to make his operation profitable he must adopt new techniques and practices as soon as these ideas are proved profitable. If calves born during certain seasons are more profitable than calves born during other seasons, the operator should attempt to have as many calves as possible born during this season. If breeding efficiency is superior during certain seasons, certainly the operator should try to take advantage of this factor in his breeding program.

Most cow-calf operators in Eastern Oklahoma desire fall or winter calves in order for these calves to be old enough to take advantage of the good grazing available in the spring. In addition, these so-called "early calves" are believed to develop better and look better all of their lives than calves born in late spring or early summer in this area.

Artificial insemination is a practice that has been used very little in commercial beef cow herds in Eastern Oklahoma. It's use is fairly common in dairy herds. As is true with most practices, artificial insemination has both advantages and disadvantages.

Artificial insemination of beef cows allows the operator to breed a large number of cows to an especially valuable sire or sires and, thus, is a means of getting a more uniformly bred calf crop. Bulls

used artifically are less apt to injure themselves than when used naturally. If a large number of cows must be bred, the total investment in bulls would be lower with a few bulls used artifically. Artificial insemination is an especially valuable practice for purebred breeders anxious to raise a large number of daughters of a certain sire.

Among the many disadvantages of artificial insemination are the following: it requires more labor and the services of more highly trained personnel, it requires additional equipment. Probably the most important consideration is that often conception rates are lower than those commonly obtained with natural service.

A study of breeding and calving records of purebred Angus cows on the Kermac Ranch, Poteau, Oklahoma, was made to determine the effect of several factors in the reproductive performance of artificially inseminated beef cows. The factors studied were: age of cow, year of cow's birth, season of breeding, difficulty of first conception, and delaying rebreeding.

REVIEW OF LITERATURE

Most studies of this type have been made on dairy cows, probably due to the fact that artificial insemination has been practiced more widely and for a longer time with dairy herds.

The only extensive study with beef cattle was reported by Lindley et al (1958), utilizing breeding records from Turner Hereford Ranch near Sulphur, Oklahoma. This study covered the years 1935 through 1952. There were 848 cows with 3,606 gestations included in the study. Cows were bred naturally during the years 1935 through 1946, and after 1946 all of the breeding was artificial. The average number of services per conception was 1.7. Cows bred more than 60 days postpartum required fewer services per conception than those bred prior to 60 days postpartum. In general they found the reproductive performance was higher in summer and fall than in winter and spring. Performance of cows declined rapidly after cows reached ten years of age. These cows grazed native, tall grass pastures.

Herman and Edmondson (1950) collected data that tended to emphasize the fact that reproductive functions of the dairy cow are at their highest level of efficiency between the second and fourth calves, or from about three to seven years of age. In their study the average interval from calving to estrus was: for first calf heifers 63 days, second calf cows 53 days, third calf cows 55 days, fourth calf cows 50 days, and fifth calf cows 60 days. Older cows showed a definite trend toward a longer calving to estrus interval similar to first-calf

heifers.

The season of the year in which breeding is carried out can have an important influence on conception rate. Fryer et al (1958) in a study of dairy cows reported that the nonreturn rate was low in July and August, rose rapidly through September and continued to rise to a peak in December. The highest average nonreturn rate occured in the fall season and the lowest in the summer.

A number of studies have shown that the length of the postpartum interval from calving to breeding is another factor affecting the number of cows that settle to first service. Trimberger (1954) in a study of records of dairy cows bred 60 days or less postpartum, 61 to 90 days postpartum, and more than 90 days postpartum showed first service conception rates of 48 percent, 70 percent, and 76 percent respectively. Including all services to fertile cows, he found the average number of services per conception were: first service 50 days or less postpartum 2.52; 51 to 60 days postpartum 1.65; 61 to 90 days 1.55; and over 90 days 1.54. In his study, cows bred 50 days or less postpartum averaged 100.5 days from parturition to conception.

Perkins and Kidder (1963) in a study of beef cows hand mated naturally, found the conception rate at first service significantly higher for cows bred 79 days or longer postpartum than for cows bred at shorter postpartum intervals. However, they found the interval from calving to conception was signficantly shorter for cows bred at a postpartum interval of 79 days or less.

If a cow is bred at 79 days or more postpartum and fails to settle to first service, she cannot calve again within 365 days of her previous calving since the average gestation period is 283 days and the

estrus cycle is about 20 days.

Van Demark and Salisbury (1950) in a study of dairy cows found that fertility increased with the length of the postpartum interval to first service up to 100 to 120 days.

Time of insemination with reference to start of estrus can have an important influence on conception rate. Rice et al (1957) reported that length of estrus averaged between 16 and 20 hours but may vary from a few hours to more than a day, and that ovulation occurs ten to fourteen hours after the end of heat.

Trimberger (1948), in a study of dairy cows artifically inseminated, found the best conception rates were obtained in females bred more than six hours but less than 24 hours before ovulation. He found that cows in heat in the morning must be bred that same day for good results. These cows first observed in heat in the afternoon, and which were definitely not in heat during that morning can be inseminated at the most opportune time the next morning. His findings agree, closely, with the statement that ovulation usually occurs 10 to 14 hours after the end of heat and that heat usually lasts 16 to 20 hours.

Asdell (1957) studied records of 19,000 dairy cows in Artificial Insemination Cooperatives. His study showed the soundness of the usual advice (1) cows detected in heat in the morning should be bred during the afternoon of the same day, and (2) cows first detected in heat in the afternoon should be bred early the next morning. Too, Asdell found the highest conception rate was obtained when cows were bred 70 to 90 days postpartum.

MATERIALS AND METHODS

The data for this report were gathered from office records of Kermac Angus Ranch, Poteau, Oklahoma. These records show dates of insemination, name of sire, and date and sex of calves born. In addition, although not used in this report, the insemination records show the opinion of the inseminator as to whether the cow was in heat or not. The data used in this report covered only artificial insemination carried out on purebred cows born on the ranch.

Each group of females born on the ranch were assigned a letter prefix to their herd number which denotes the year born. Four groups of cows born on the ranch were used in this study. They were identified by the prefixes E, G, H, and I.

The E cows were born in 1956, the first year the ranch was in operation. Their calving dates varied widely from January 16 to November 22. Three cows were born during the first quarter, six during the second quarter and two during the last quarter.

The G cows, born in 1958, had more uniform birth dates. Of their group 44, 21, 8 and 15 were born during the first, second, third and fourth quarters, respectively. The management of this ranch felt that calves dropped during the fall and winter generally developed into better looking individuals than calves dropped during the spring and summer.

The H cows studied contained 17, 31, 9, and 11 cows born during the first, second, third and fourth quarters of 1959, respectively.

The I cows were born in 1960 and included 19, 31, and 18 cows born during the first, second and third quarters, respectively. No cows born during the last quarter of 1960 were added to the breeding herd. Only three cows born during the months of June, July and August of 1960 were added to the breeding herd.

There seems to be a difference in the performance of H and I groups of cows. It was pointed out by the inseminator that I cows were handled during their first breeding season by an employee who consistently did a better job of detecting cows in heat. Too, this group of cows seemed to perform better, and practically all were bred for their first calves to a bull who had an outstanding record for settling cows.

The usual practice on this ranch is to hold cows open for 60 days after calving before starting inseminating. Cows showing evidence of heat in the morning are penned that morning and inseminated that afternoon. Cows detected in heat during the afternoon are inseminated the following morning. All cows that will stand for riding by another cow the next day after breeding are inseminated again that day.

The inseminator on the ranch when this study was made, Mr. Wesley Cupp, gave these instructions for detecting heat in cows. Spend at least one hour with the cows early in the morning and look for the following signs of heat: standing for another cow to ride, ruffled hair on tail head, mud or dirt on cow's sides, vulva swollen, mucuous discharge from vulva, head held high and appearing somewhat nervous and gaunt. Each group of cows should be checked again just after noon and again late in the afternoon.

After insemination wet cows are put back in the pasture with other wet cows. Virgin heifers and dry cows are put into separate pasture after insemination. Heifers are checked for pregnancy approximately 60 days after breeding. Cows are examined for pregnancy about 75 days after breeding.

When the inseminator inseminates a cow or heifer he notes, whether, in his opinion, the cow or heifer is in heat. However, she is inseminated regardless of his opinion as to heat. If palpation at time of insemination reveals some abnormality in the cow's uterus she is not inseminated. If a cow in heat has been bred twice, she is not bred but is allowed to pass over another heat period before breeding.

All inseminations were made with frozen semen collected, processed and stored at the ranch. Dry ice and alcohol were used until 1958 when a liquid nitrogen unit was installed. Semen with a concentration of one and one-half billion sperm cells per cubic centimeter was diluted 20 to one. Semen with a sperm cell count of less than one billion was diluted ten to one. Citrate and egg yolk was used as a diluter.

Until 1963 a graduate veterinarian was in charge of all breeding operations. It is felt that reproductive diseases were well controlled. Since 1963 a young man, Mr. Wesley Cupp, who was trained by this veterinarian, has done the breeding work.

RESULTS AND DISCUSSION

Influence of Age: The relationship between age of cows and breeding efficiency as measured by percent settling to first service and average services required per conception is given in Table I. As has been reported in other studies, the breeding efficiency of the Angus cows in this study steadily increased after the first conception through five years of age. Although the data reported in Table I showed a sudden decrease in breeding efficiency between five and six years of age, it is felt that the limited number of cows studied at ages past five years could not be a very true indicator of the actual breeding efficiency of cows at these ages.

The fact that the performance of seven-year old cows is very comparable to the three through five-year old group suggests that the figures for the six-year old group are not representative. The eight-year old group is included only because there was data available.

Most of the conception data for ages past five years were from cows in the E group, which were never as efficient in reproductive performance as the other groups of cows. The reason for this is not known but there are several factors that may have contributed to this poorer performance. Perhaps the poor start for these cows carried over into their later years, while the rapid improvement in pastures gave the cows born later a better start or better physical development. There is the possibility that some of the other groups of cows were handled by more efficient employees and this contributed to the relative

inefficiency of the E cows. It is also possible that other groups of cows in this study were bred to bulls whose semen was of better quality than the semen used in breeding the E cows. However, every effort was made to use only semen of good quality as far as could be determined by microscopic examination.

TABLE I

THE INFLUENCE OF AGE OF ANGUS COWS ON BREEDING EFFICIENCY AS MEASURED BY CONCEPTION RATE TO ARTIFICIAL INSEMINATION

Age (Years)	Total Number	Settling to First Service		Average Services For Conception
		Number	Percent (%)	
1	224	76	33.93	2.75
2	209	104	49.76	2.07
3	166	104	62.65	1.66
4	85	49	57.65	1.83
5	52	31	59.62	1.73
6	26	10	38.46	2.38
7	19	12	63.16	1.84
8	2	1	50.00	2.50
Total	783	387	49.43	2.14

The data reported in Table I reveals that the best conception rate to first service obtained was approximately 63 percent. The average for the three peak years, three-, four-, and five-years of age, was approximately 61 percent. The data also indicates that in this herd the rebreeding performance of two-year old heifers was poorer than that of older heifers since only 50 percent conceived to first service.

The poorer rebreeding of two-year old heifers is a common complaint even with natural service.

Table II is a summary of the percent of cows of each age group conceiving on services one through four and those requiring more than four. The only group in which any sizeable number of cows required more than four services was the yearling group. For the entire study 49.43 percent settled to first service, 23.37 percent required two services, 11.75 percent required three services, 6.64 percent required four services and 8.17 percent required more than four services.

TABLE II

PERCENT OF COWS OF EACH AGE GROUP CONCEIVING AT SERVICES ONE THROUGH FOUR OR REQUIRING MORE THAN FOUR SERVICES

		PERCENT OF TOTAL COWS CONCEIVING ON SERVICE NUMBER:				
Age	No. Cows	1	2	3	4	More Than 4
1	224	34	27	12	8	18
2	209	50	24	13	8	4
3	166	63	17	12	5	3
4	85	58	26	8	2	6
5	52	60	19	10	4	6
6	26	38	34	14	10	3
7	19	63	10	10	10	6
8	2	50	0	0	50	0
Total	783	49	23	12	7	8

Influence of Season: Figure 1 shows the percentage distribution of the calves studied for this report by months. Soon after the establishment of Kermac Ranch, the management decided that fall calves suited their feed and pasture program better than year round calving. Fall and winter born calves are old enough to eat a substantial amount of the lush vegetation available in pastures in the spring. Too, the ranch has a sizable acreage of fescue and ladino pasture. Some winters, if late summer and early fall rainfall is adequate, these pastures afford good forage for cows and fall calves.

Although fall and winter calving cows require more feed for the wintering period their calves can be weaned early in the summer and the dry cows carried on some of the lower quality pasture forage available during the summer.

As mentioned previously, fall and winter calves are more attractive at weaning age than spring and summer born calves. Figure 1 gives distribution of calvings by months of the calves in this study.

Comparatively, few inseminations were made during the last half of the year. At the time this study was made, inseminations were no longer being made from June through November. Therefore, all of the summer and fall breeding included in this summary were made on cows of the E and G groups.

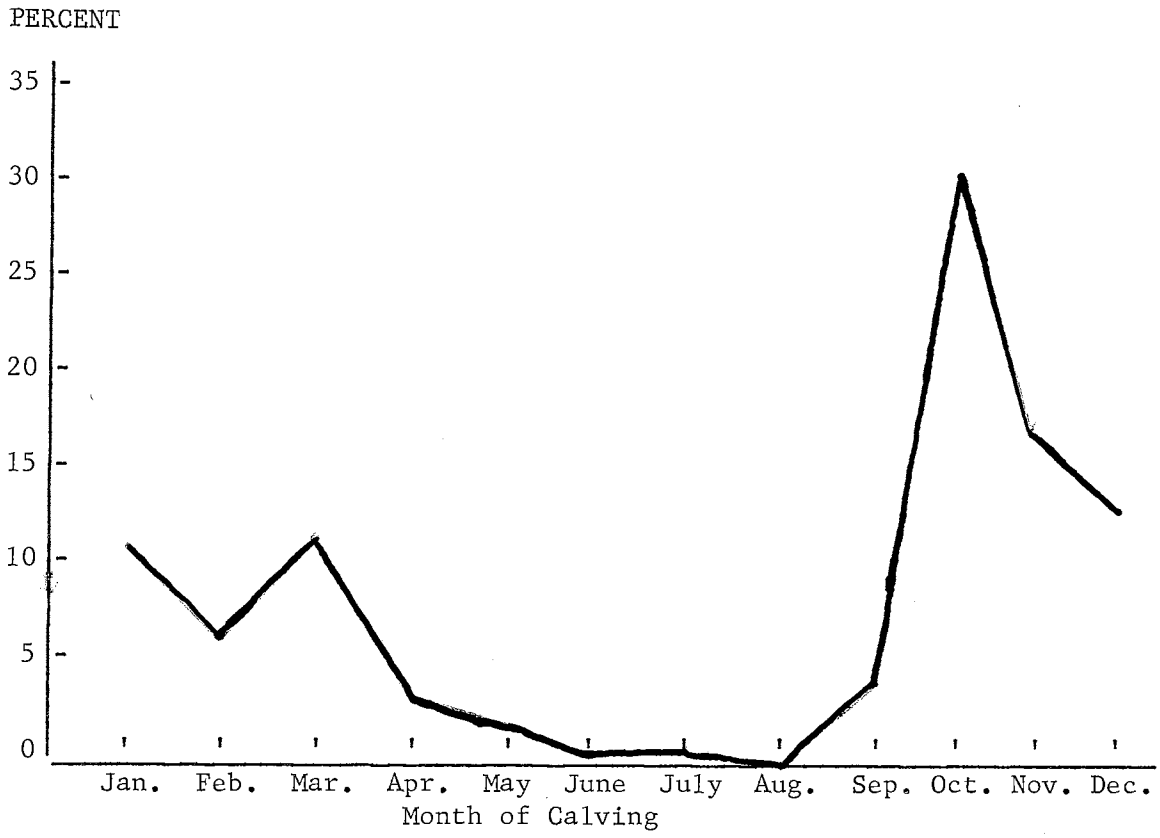

FIGURE 1. DISTRIBUTION OF CALVING BY MONTHS

In this study the data reported in Table III and Figure 2 show that the breeding efficiency was highest when insemination was started during the first quarter of the year. The percent of cows settling to first service (50 percent) during the fourth quarter is only slightly lower than the 51.78 percent settling to first service during the first quarter. However the fourth quarter group required .17 more services per conception. Also it should be pointed out that only a limited number of cows were bred during the fourth quarter.

It would appear that enough cows were inseminated in the first and second quarters to make the data meaningful. There is a definite difference in conception rate to first service (51.78 vs. 46.67 percent), and in services required per conception (2.04 vs. 2.27) in favor of the

first quarter. While the reason for this cannot be determined from the data available for this study, it is likely a reflection of the nutritional status of the cows. The lower nutritional level on which the cows are carried during the winter had more time to adversely affect the cows by the end of the wintering period.

During the second quarter pastures are lush and the cattle scattered more in the pastures. This makes heat detection more difficult. Some feel that spring pastures in Eastern Oklahoma are so watery that cows actually do not get enough energy to breed successfully. Dr. Dan Goodwin, ranch veterinarian during the first three years of this study, felt that perhaps white clover contains estrogens that might inhibit or affect in some way the estrus cycle in cows. White clover was quite prevalent in most Kermac pastures during the second quarter of the years studied.

TABLE III

INFLUENCE OF SEASON OF YEAR ON BREEDING EFFICIENCY OF ANGUS COWS AS MEASURED BY CONCEPTION RATE TO ARTIFICIAL INSEMINATION

Season Insemination Commenced	Number	Conception To First Service	Percent Conception To First Service	Average Services Per Conception
1st Quarter	533	276	51.78	2.04
2nd Quarter	165	77	46.67	2.27
3rd Quarter	29	6	20.69	3.21
4th Quarter	56	28	50.00	2.21
Total	783	387	49.43	2.14

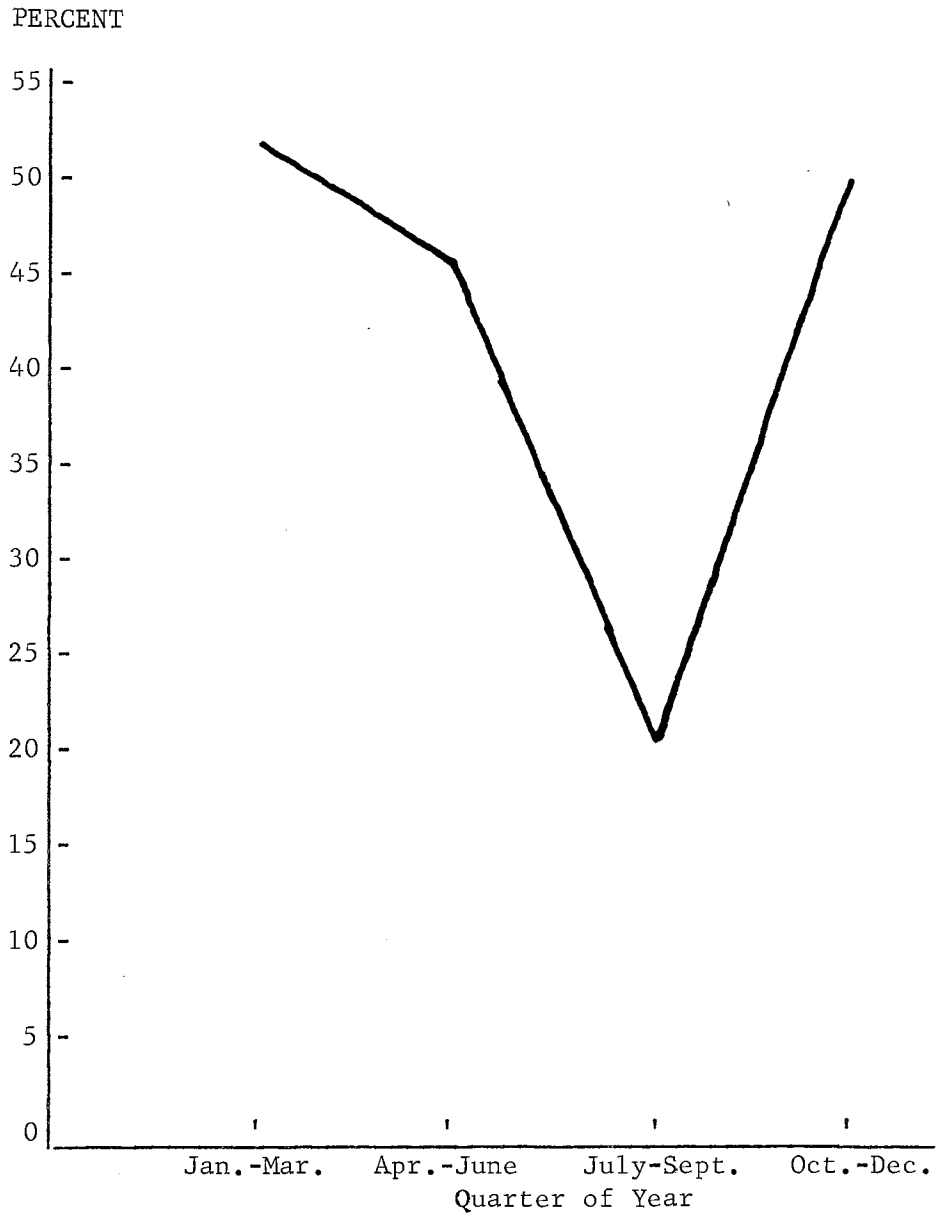

FIGURE 2. PERCENT OF COWS SETTLING TO FIRST SERVICE BY SEASONS OF YEAR

Breeding Efficiency of Different Groups of Cows: As discussed earlier four groups of cows were studied for this report; E cows, born in 1956, G cows, born in 1958, H cows, born in 1959 and I cows born in 1960.

Table IV shows the differences in average services per conception and percentage settling to first insemination of these groups of cows.

TABLE IV

BREEDING EFFICIENCY OF GROUPS OF COWS

Group	Year Born	Number Years Breeding	Number of Conceptions	Services For Conception	Percent Settling To First Services
E	1956	8	136	2.55	44.85
G	1958	6	306	2.04	51.96
H	1959	4	176	2.26	41.48
I	1960	3	165	1.87	56.97
Total			783	2.14	49.43

The I cows were superior to the other groups of cows in both of the above mentioned categories. It was mentioned earlier in this report that these cows were handled during their first breeding season by an employee considered the best at detecting heat in cows. Too, a large percentage of these cows were bred to a bull whose semen was considered better than the semen of any other bull on the ranch.

It is interesting to note that the E cows had a higher average number of services per conception than the H cows (2.55 vs. 2.26). However, the H cows were inferior to the E cows in the percentage settling to first service (44.85 vs. 41.48). This is a reflection of the poor conception rate of cows of the E group that did not settle to first service.

The averages for all groups included in this study, as given in Table III, gives a picture of the breeding efficiency of this herd. For a total of 783 conceptions, an average of 2.14 services were required per conception, and 49.43 percent settled to first service.

This is somewhat poorer than the 1.7 services per conception reported by Lindley et al (1958) for a large purebred Hereford herd.

Tables V through VIII show the percentage of each of the different groups of cows settling to different services at each age. It is very noticeable that the E cows had a poor breeding year for their first calves since 57 percent of them required more than four services to conceive. Perhaps the fact that these cows were bred for their first calves soon after the ranch began operations caused this trouble. Handlers had to be trained to detect heat, and the inseminators had to perfect their techniques of semen gathering, semen storing and insemination.

It is also very noticeable that the I cows were very good breeders for their first calves. Only five percent required more than four services to conceive for their first calves. The inseminator's statement that these I heifers were handled by the outstanding employee seems well founded.

Perhaps the fact that these I heifers were bred for their first calves during 1962 accounted for some of their good conception rate. 1961 was a very favorable rainfall year and perhaps the heifers were grown out better by the time insemination started in 1962.

A steady improvement was shown by the percent of cows settling to one or two services for their first calves. Just 28 percent of the E cows settled to one or two services for their first calves. This percentage increased to 56 percent for the G cows to 63 percent for the H cows and to 80 percent for the I cows.

It is possible that there is a combination of several factors contributing to the gradual improvement in the percentage of heifers bred

with one or two services. A listing of these factors might include: pasture improvement, having more calves born during "more favorable" seasons of the year, better heat detection and insemination techniques, and the addition of bulls with better quality semen.

TABLE V

DISTRIBUTION OF CONCEPTIONS TO SERVICES ONE THROUGH FOUR AND MORE THAN FOUR FOR COWS OF GROUP E AT AGES ONE THROUGH EIGHT YEARS

		PERCENT OF COWS CONCEIVING ON SERVICE NUMBER:				
Age	No. Cows	1	2	3	4	More Than 4
1	21	14	14	5	10	57
2	21	38	24	10	14	14
3	21	38	19	19	5	14
4	20	50	25	5	15	5
5	17	76	24	0	0	5
6	15	47	20	13	13	6
7	19	53	11	11	11	5
8	2	50	0	0	50	0

TABLE VI

DISTRIBUTION OF CONCEPTIONS TO SERVICES ONE THROUGH FOUR AND MORE THAN FOUR FOR COWS OF GROUP G AT AGES ONE THROUGH SIX YEARS

Age	No. Cows	PERCENT OF COWS CONCEIVING ON SERVICE NUMBER: 1	2	3	4	More Than 4
1	80	23	33	23	4	18
2	70	76	11	6	3	3
3	63	57	14	16	10	2
4	47	62	26	11	0	2
5	35	71	17	9	0	3
6	11	45	36	9	9	0

TABLE VII

DISTRIBUTION OF CONCEPTIONS TO SERVICES ONE THROUGH FOUR AND MORE THAN FOUR FOR COWS OF GROUP H AT AGES ONE THROUGH FOUR YEARS

Age	No. Cows	PERCENT OF COWS CONCEIVING ON SERVICE NUMBER: 1	2	3	4	More Than 4
1	59	25	36	7	12	18
2	56	45	16	20	5	13
3	43	65	21	12	2	0
4	18	50	28	6	0	11

TABLE VIII

DISTRIBUTION OF CONCEPTIONS TO SERVICES ONE THROUGH FOUR AND MORE THAN FOUR FOR COWS OF GROUP I AT AGES ONE THROUGH THREE YEARS

		PERCENT OF COWS CONCEIVING ON SERVICE NUMBER:				
Age	No. Cows	1	2	3	4	More Than 4
1	64	63	17	8	6	5
2	62	47	29	11	8	5
3	39	64	18	10	3	5

Breeding Efficiency By Years: Table IX shows how breeding efficiency varied by years. Attention is called to the limited number of conceptions during the first two years of this study. Too, these first two years consisted of just one group of cows, the E's, which never seemed to perform as well as other groups.

The last three years represented in this study showed much better breeding efficiency than the average of the study. Perhaps there was an improvement in the skill of the men handling the cows and in the skill of the inseminator.

One might assume that the poor results during the years 1957 through 1959 were due to faulty techniques that were later corrected. However in considering the last five years of breeding covered by the study, 1960 through 1964, it is very obvious that 1961 was a poor year. During that year the percentage of cows settling to first service was much lower than the previous year and the following year. Too, 1961 average of services per conception was higher than any other of the five years 1960 through 1964.

TABLE IX

BREEDING EFFICIENCY COMPARED BY YEARS

Year	Number Conceptions	Settled To First Service	Percent Settled To First Service	Average Services Per Conception
1957	20	3	15.00	4.90
1958	14	5	35.71	2.50
1959	91	24	26.37	2.91
1960	70	43	61.43	1.81
1961	145	68	46.89	2.19
1962	170	92	54.12	1.89
1963	161	89	55.28	1.86
1964	112	63	56.25	1.91
Total	783	387	49.43	2.14

1961 was characterized by very favorable rainfall. Kermac Ranch's pastures grew an abundance of white clover that year and bloat was a serious problem during April and early May in the fescue-ladino pastures.

There is a feeling among some cattlemen that white clover is not as good a pasture plant as commonly thought. This feeling is stronger during seasons when the sward is predominately white clover. It may be that, although white clover is quite high in protein and vitamins, it is too watery to provide enough energy for the cows to go through the estrus cycle regularly.

Dr. Dan Goodwin's feeling that white clover may contain enough estrogen to affect the cow's regular estrus cycle is supported by the

results of this study. Dr. Goodwin repeatedly stated that he would rather inseminate cows during the winter than during the spring and summer.

The feeling is quite common among Eastern Oklahoma cattlemen that cattle "do better" during dry years than during wet years. If this feeling among cattlemen is true, perhaps the same factors that affect "doing" of cattle affect their breeding efficiency.

It is commonly assumed that stomach worms are worse in damp climates than in drier climates. It is possible that stomach worms reduced the gain of cattle in 1961 and thereby affected the breeding efficiency of cows in this study.

Rainfall during 1962 was much lower than in 1961. 1963 and 1964 were very dry years in LeFlore County. Supplemental feeding started earlier than usual in 1962, 1963 and 1964.

Effect of Delaying Breeding on Breeding Efficiency: Table X presents data on the breeding efficiency of cows delayed for 90 days or more before breeding. Most of these delays were the result of a cow's being open at the end of the breeding season. Rather than breeding a cow to calve during the late spring or summer, breeding was delayed until about December 1. As stated earlier, management of this ranch decided that fall and winter calves suited their operation better than late spring or summer calves. It is also a practice on this ranch to delay breeding for two heat periods if two consecutive inseminations have failed to result in conception.

Cows represented in Table X were delayed from 90 to 320 days. Average length of delay was 139 days. Delays of more than three to four months were usually due to some problem with the cow such as

disease or failure to come in heat.

The values shown for the average number of services per conception given in Table X are the same figures as shown in Table I and are repeated here for comparison. Table X shows that in all age groups except three-year olds there was improvement in breeding efficiency after the cows were delayed. However, it should be pointed out, that only in the one and two-year old groups were the numbers large enough to be meaningful.

TABLE X

EFFECT OF DELAYING BREEDING FOR 90 DAYS OR MORE ON BREEDING EFFICIENCY OF ANGUS COWS

Age Of Cow	Number Cows	Number Previous Pregnancies	Number Cows Bred Three or More Times Before Delay	Average Services Per Conception After Delay	Average Services Per Conception Of All Cows This Age
1	33	0	15	2.58	2.75
2	15	1	3	1.40	2.07
3	9	2	2	2.44	1.66
4	7	3	1	1.14	1.83
5	1	4	0	1.00	1.73

Literature cited earlier shows that, generally, breeding efficiency increases by lengthening the postpartum interval. Quite often the cows in this study got quite fat when breeding was delayed. Excessive fatness is commonly thought to hinder conception. If this is true, evidently these cows did not get excessively fat.

Perhaps the long sexual rest allowed the cow's reproductive organs to become more normal. Perhaps waiting until cooler weather caused this breeding improvement. Perhaps a change in feed or change from pasture to feeding caused the increase in breeding efficiency.

Problem Cows: The future breeding efficiency of a cow that is hard to settle during her first breeding season is debated by many cow owners. Some owners have cows examined for pregnancy and sell all open cows at the end of the breeding season. Turman et al, (1963) summarizing a study of grade Hereford cows through 14 years of age, found that culling of open cows would have increased the calf crop percentage approximately five percent in the following calving seasons, but would have been relatively ineffective in reducing the number of open cows in the herd in future years. Rice et al, (1961), found that beef heifers dry as three-year olds had a lifetime record of 54.9 percent calf production as against 86.8 percent for those that bore a calf the first year. If their first year's production was ignored and the heifers were compared according to what they did in future years, those dry as three-year olds had a lifetime average of 74.8 percent and those wet as three-year olds averaged 83.5 percent. The management of Kermac Ranch at the time of this study felt that if a cow difficult to breed ever becomes pregnant she is as good a breeder as any cow in future years.

In this study cows that required four or more services for their first conception were termed problem cows. Those requiring less than four services for their first conception were classified as non-problem cows. Any cow that required four or more services for a subsequent conception was also classified as a problem for that conception. For

the purpose of this study, however, a cow was classified as a problem or non-problem only on the basis of her performance during her first breeding season. She remained in this category regardless of her subsequent performance. These data are presented in Table XI.

TABLE XI

SUBSEQUENT PERFORMANCE OF PROBLEM[1] COWS COMPARED TO NON-PROBLEM COWS AS MEASURED BY CONCEPTION RATE TO ARTIFICIAL INSEMINATION

	Problem Cows	Non-Problem Cows
Number	49	155
Average services per first conception	6.14	1.70
Number of subsequent conceptions	151	412
Average services per subsequent conception	1.97	1.65
Number of times later a problem[2]	20	35
Percent of cows later a problem	40.82	22.58

[1]Problem cow is termed used to denote a cow requiring four or more services for her first conception.

[2]Requiring four or more services for a subsequent conception.

In this study it was found that cows who were problems with their first conception were less efficient throughout their subsequent reproductive lives than were non-problem cows. Almost twice as many (40.82 percent vs. 22.58 percent) of these problem cows were problems later than were cows that required less than four services for their first conception. The problem cows required 19 percent more services for all conceptions after the first one than did non-problem cows (1.97 versus 1.65).

The results of this study suggest that a cow owner could reduce future breeding problems by culling heifers that are difficult to settle. This would be accomplished by culling all heifers that are open following a limited breeding season.

SUMMARY AND CONCLUSIONS

Breeding efficiency of a purebred Angus herd, artificially inseminated, was studied for the period 1957 through 1964. A total of 783 conceptions required an average of 2.14 services per conception and 48.43 percent of these were conceptions to first services. There was a rapid improvement in services per conception during the first half of the study and very little improvement in the last half of the period studied. Rate of conception to first service varied from 15 percent to 61.43 percent but showed no significant improvement after 1960.

Breeding efficiency of cows in this study steadily increased through five years of age. Average services per conception decreased from 2.75 for one-year old heifers to 1.73 for five-year old cows. Percent settling to first service improved from 33.83 for one-year olds to 59.62 for five-year olds. Not enough records were available for cows older than five years for their data to be meaningful.

Best results were obtained when breeding started during the first quarter of the year. A total of 583 conceptions resulting from insemination starting during the first quarter required an average of 2.04 services per conception and 51.78 percent settled to first service. 165 conceptions from insemination started during the second quarter required an average of 2.27 services per conception and 46.67 percent settled to first service. A limited number of conceptions to insemination started during the third and fourth quarters indicated that the fourth quarter was much better than the third quarter.

There was a steady improvement in breeding efficiency of the cows born during the different years of the study. The percentage of cows settling to one or two services was 28 percent for cows born in 1956, 56 percent for cows born in 1958, 63 percent for cows born in 1959, and 80 percent for cows born in 1960.

The last three years of the study showed much better breeding efficiency than the average of the study. This probably reflects improvement in the skills of the men handling the cattle and the men handling the semen. However, the year 1961 was the poorest year of the last five years of the study.

There was an improvement in breeding efficiency after delaying breeding 90 days or more in all age groups except three-year olds. However, limited data for cows over two years of age were available.

Cows requiring four or more services for conception for their first calves were classified as problem cows. These cows required 1.97 services for each subsequent conception compared to 1.65 services required for each subsequent conception for non-problem cows. 40.82 percent of the cows classified as problem cows on the basis of their first breeding season required four or more services for more subsequent conception. Just 22.58 percent of non-problem cows required four or more services for a subsequent conception.

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