

conceive or maintain early pregnancy and approximately 20 percent of the ewes that maintained pregnancy for 60 to 80 days lost their lambs prior to lambing. These observations involve small numbers, but do imply some of the problems when breeding nonadapted sheep during the spring.

Table 2 represents the reproductive performance of young, unselected F₂ ewes. The performance is similar to the F₁ ewes; however, lamb livability is lower. The last column in Tables 1 and 2 indicates the light birth weights, especially on the fall-born lambs and F₂ ewes. Finnish Landrace breeding, summer heat stress and nutritional complications are probably the principal factors involved in the light birth weights.

Table 2 indicates the early maturing patterns involving Finn crossbred sheep. Three-fourths of the 8-month-old ewe lambs bred in the spring at weights under 100 lb and one-third lambled.

A few ewes in the flock continue to be excellent producers during the fall and spring. These are the ewes that the selected line will be based upon to develop a superior reproductive line of fall-lambing sheep.

Table 2. Reproductive performance of F₂ ewes

Breeding season	Ewes exposed	Percent mated	Percent lambled	Lambs per ewes lambing	Average birth wt
Spring 1979	20	95.0	50.0	1.50	4.47
Spring 1980					
Aged ewes	17	64.0	29.4	1.80	5.24
Ewe lambs ^a	19	73.7	31.6	1.67	4.52 ^b

^aEwes less than 9 months old.

^bOnly six recorded birth weights.

Repeatability of Ewe Reproductive Performance

Joe V. Whiteman and J. M. Dzakuma

Story in Brief

Lifetime reproductive records of the crossbred ewe flock (initially 263 ewes) at the Southwest Livestock and Forage Research Station were analyzed to investigate the consistency (repeatability) of reproductive performance of the ewes. The ewes were born in 1971 and 1972 during the spring and bred to lamb at 1 year of age. They lambled one or two more times during late winter, lambled twice during the fall (1974 and 1975) and then followed an accelerated lambing program involving six lambings during the next 4 years. Thus, the 75 to 80 percent of the ewes surviving had 10 or 11 lambing opportunities.

The first analysis determined average subsequent reproductive rates of ewes that produced 0, 1 or 2 lambs at 1 year of age to be 1.33, 1.49 and 1.60 respectively. The performance of the ewes at 1 year was a much better indicator of average lifetime performance than was the ewes' second record where ewes producing 0, 1, 2 or 3 lambs subsequently produced an average of 1.36, 1.42, 1.47 and 1.56 lambs per opportunity.

The third analysis calculated repeatability of reproductive rate to be 0.14 indicating an individual record chosen at random to be a poor indication of the average reproductive rate of a ewe. Only the relative reproductive rate of ewes at their first lambing opportunity (first analysis) appears to be a reasonably reliable indicator of lifetime reproduction.

Introduction

In the process of trying to develop a flock of highly productive sheep, producers select certain ewe lambs as replacements and/or cull certain producing ewes. The effectiveness of the culling is proportional to the extent that poor observed performance is an indicator of future performance, i.e., how consistent animals are in their performance for different characteristics. In animal breeding terminology this consistency is referred to as the repeatability of a trait. For instance, if a producer measures the amount of wool that each ewe produces in 1 year and then measures each of the same ewes the next year, he will find there is a strong tendency for the ewes that produced the heavier fleeces the first year to produce heavier fleeces the second year and for producers of the lighter fleeces to repeat their ranking of lighter fleeces. Wool production is said to have a high repeatability, and culling a flock for poor wool production will be effective in increasing wool production.

The traits of greatest importance in determining ewe flock productivity where lambs are the principal product is the rate of reproduction or percent lamb crop. To cull ewes for poor productivity, a producer might cull on the basis of the ewe's performance at her first opportunity (lambing) or at other lambings. To know how effective this technique would be in increasing the productivity of the flock, it is necessary to determine the repeatability of reproduction rate.

The purpose of this study was to determine the value of a ewe's (1) first, (2) second or (3) any record as an indication of her overall reproductive performance.

Materials and Methods

In March and April of 1971 and 1972, 263 crossbred ewes of five combinations of Finnsheep (F), Dorset (D) and Rambouillet (R) breeding were produced at the Southwest Livestock and Forage Research Station (Ft. Reno), El Reno, Oklahoma. The five breed combinations represented were: $\frac{1}{2}D\frac{1}{2}R$ (55); $\frac{1}{4}D\frac{3}{4}R$ (59); $\frac{1}{4}F\frac{1}{2}D\frac{1}{4}R$ (54); $\frac{1}{4}F\frac{1}{4}D\frac{1}{2}R$ (56); and $\frac{1}{4}F\frac{3}{4}R$ (39). The $\frac{1}{4}F\frac{3}{4}R$ ewes were produced in 1972 only. The reproductive performance of these ewes when lambing in the winters of 1972, 1973, 1974 and the fall of 1974 and 1975 has been reported in *Animal Science and Industry Research Reports* of 1974, 1975 and 1976. The ewes' productivity under two cycles of accelerated lambing or lambing every 8 months (1976-1979) was reported in 1980.

The ewes were first lambed at yearly intervals in spring, 1972, late winter, 1973, and winter, 1974. In 1974, they were again bred in May and June to lamb in fall, 1974. In May-June, 1975, they were bred to lamb in fall of 1975. They were bred in winter (January-February), 1976, to lamb for the first time in summer, 1976, and after that they were bred every 8 months. The fall breeding season was (September-October) leading to winter lambing. The late-spring season (May-June) was the third breeding time for the accelerated lambing program. The ewes went through two cycles of accelerated lambing each with three breeding and lambing seasons.

During the 1971, 1972 and 1973 fall breeding seasons, purebred rams of Suffolk and Hampshire breeding were used. Starting with the late-spring, 1974, breeding, four purebred and four crossbred rams were used each season. They were of Suffolk, Hampshire, Suffolk x Hampshire or Hampshire x Suffolk breeding and were a minimum of 15 months old at breeding time.

The project was terminated after the fall of 1979 lambing at which time some of the ewes had had as many as 10 or 11 lambing opportunities.

A repeatability estimate needs to be interpretable to a normal flock consisting of one breed of ewes and rams lambing at one time of year. In order to put the data from the experimental flock on that basis, the production records of the ewes were adjusted to remove breed of ewe and breed of ram differences and also those seasonal differences that affected ewe reproductive performance.

The adjusted data were then used to determine how good an indicator of average ewe performance some records were. The *first* analysis determined the average productivity at each subsequent lambing of those ewes that produced 0, 1 or 2 lambs at their first lambing opportunity at 12 months of age. The *second* analysis ignored each ewe's first lambing and determined the average productivity at each subsequent lambing of those ewes that produced 0, 1, 2 or 3 lambs at their second lambing opportunity at about 23 months of age. The *third* analysis attempted to determine the average relationship of any individual lambing record to all other records of the ewe.

Results

If producers raise their own ewe replacements, they can treat all ewe lambs raised in any year uniformly and measure their reproductive rate under their own conditions. In order to determine how valuable a ewe's first production records would be, the first analysis was done. The results are presented in Table 1. These data indicate that ewe lambs that did not lamb at their first opportunity produced an average of 1.33 lambs per opportunity for the rest of their lives as compared to an average production of 1.49 for those producing a single or 1.60 for those producing twins at their first opportunity.

Table 2 presents the average subsequent production of ewes that produced 0, 1, 2 or 3 lambs at their second opportunity. The increase in subsequent average production for each additional one lamb produced at the second opportunity was much less than the increases shown in Table 1. This indicates that the performance of a replacement ewe at about 1 year of age is a much better predictor of her lifetime production than is her record at about 2 years of age.

The third analysis as indicated earlier was an analysis to estimate the average relationship (agreement) among many measures (records) on the same individual throughout a lifetime. The number that comes out of the analysis is called the repeatability and will always be between 0 and 1.0. A value near 0 indicates there is little consistency of performance and suggests that one record on the individual chosen at random would not be expected to be a good predictor. A value near 1.0 would suggest

Table 1. Average number of lambs born per subsequent lambing opportunity of ewes that produced 0, 1 or 2 lambs at 12 months of age

Item	First production rate		
	0	1	2
No. ewes	93	144	25
Av. subseq. prod.	1.33	1.49	1.60

Table 2. Average lambs born per subsequent opportunity to ewes producing 0, 1, 2 or 3 lambs at about 23 months of age

Item	Second production rate			
	0	1	2	3
No. ewes	45	92	109	5
Av. subseq. prod.	1.36	1.42	1.47	1.56

consistent performance, and one record at random would be a good indicator of average performance. The value that came out of the third analysis for repeatability of reproductive rate from the adjusted record for these ewes was 0.14. Since this value is near zero, these data suggest that one reproductive rate record chosen at random on one of these ewes was not a good indicator of her average reproductive performance.

Discussion

The results from analyses of the records on the lifetime performance of these ewes are in remarkable agreement with similar analyses made by other scientists under other conditions. The results from the first analysis indicate that when ewe lambs are raised under uniform conditions, and the number of lambs that they have at their first opportunity is used as an indicator of their average lifetime productivity, the predictability of that first measurement is pretty good. The ewe's lifetime performance for reproduction is the best measure that we have of her inherent fertility. The fact that at the first lambing opportunity these ewes were sorted into three groups with such widely different average lifetime productivity indicates that the first record was a reliable tool for sorting the ewes on inherent fertility.

There has been research in Australia, Canada and one or two other areas around the world using similar records either with early maturing sheep 12 months old or later maturing sheep, such as Merinos, 24 months old that indicates the first record of reared replacements has about the predictability that these analyses show, which is considered to be good predictability. Analyses of data of Rambouillet yearling ewes purchased several years ago at this station showed similar results. When these ewes were lambed first, at about 19 months of age, those yearling ewes that had twins the first time they had an opportunity to lamb were considerably more fertile, on the average, for the rest of their lifetimes than were the other ewes. These results suggest that those producers who would like to improve the productivity of their ewe flock can do so. They can produce their own ewe lambs, rear them under uniform conditions, rear more than they need and then on the basis of the first productivity of these ewes, sell those that do not lamb. Permanent identification of those that have twins would be a good idea also because such ewes should produce future replacements.

The second analysis indicates that there is some value to a ewe's second lambing record, but it is not nearly as great as the value of the first record. Producers might not find it beneficial to have their young ewes produce two lamb crops before they cull them because the second record may not give enough additional value over the first one to make the increased accuracy worthwhile. Other scientists who have studied such production records, seem to agree on the lower value of the second record.

The third analysis, which found the repeatability of .14, agrees with general opinion that as far as reproduction is concerned, one record chosen at random on an individual is not a very good predictor of reproductive performance of the individual. Because of the unreliability of such predictions, few animal breeders would recommend that older ewes be culled just because they fail to lamb one time. Among mature ewes, whether or not a ewe lambs or whether she has twins is not believed to be a very good indicator of her inherent fertility.