A STUDY OF SOME FACTORS AFFECTING BIRTH WEIGHT AND PASTURE GAINS OF LAMBS

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by

Ralph E. Morrow

AN ABSTRACT

Submitted to the School of Graduate Studies of Michigan State College of Agriculture and Applied Science in partial fulfillment of the requirements for the degree of

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The importance of evaluating the growth potentialities of lambs at an early age has long been recognized by the producer. Attempts to study intensively this highly interesting phenomenon of growth in lambs have been quite limited. This work is an attempt to establish the relative importance of some of the factors that influence birth weight, weaning weight and growth on pasture of the Columbia, Corriedale, and Suffolk sired lambs out of western ewes.

Kincaid (1943) in a study of 1800 lambs born over a 14 year period found birth weight to be one of the factors that influenced growth. Foster (1926), Phillips, Stoehr, and Brier (1940), Kean and Henning (1949), Phillips and Dawson (1937) all found the mean birth weights of single ram lambs to be heavier than single ewe lambs and the latter heavier than twin lambs. Blunn (1944) in a study of birthweights of Navajo lambs found no significant difference between the mean birth weights for lambs having the same sires and dams, or the same sires but different dams. Phillips and Dawson (1937) found weight at birth to be significantly associated with weight at 3 months of age. In a study of weights on Navajo lambs at 28 day intervals from birth to weaning, Blunn (1942) reported significant differences between the mean monthly weights for the several years studied. Singh (1953) reported a significant correlation between growth of lambs and May rainfall.

The data used in this study were obtained from the Michigan State College Experimental ewe and lamb flock handled under farm flock conditions. The project records were kept for 1952 through 1954. The prenatal growth was studied by birth weights and the lambs growth on pasture

analyzed by weighing each lamb at 2 week intervals and recording this information.

The effect of some environmental factors on growth was studied such as time of birth, type of birth, sex, year, weaning, existing climatic conditions, and breeding of sire.

Analysis of the data disclosed the following results:

1. The mean birth weights of the single male lambs were heavier than those for single ewe lambs. The mean birth weight for twin lambs was less than the single lambs.
2. The lambs dropped during the first half of the lambing season were heavier than those dropped after the mid-point.
3. The correlation coefficients between rainfall and lamb growth were not statistically significant.
4. The correlation coefficients between solar radiation and lamb growth during the pasture study were not significant.
5. The coefficients of correlation between birth weights and weaning weights were statistically significant.
6. The coefficients of correlation between weights of the lamb and ewe at weaning time were statistically significant.
7. The Suffolk sired lambs had the largest average daily gain and weaning weight during the pasture study. There was a significant difference in pasture growth of the Suffolk sired lambs over the Columbia sired lambs in 1953. The same difference was noted in the Columbia sired lambs over the Corriedale sired lambs in 1954.

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TABLE OF CONTENTS

TABLES LISTED

INTRODUCTION

Growth is one of the most important factors confronting the sheepman. While this highly complicated and interesting phenomenon is universal, attempts to study it intensively in lambs have been quite limited.

Lambs are unequaled among farm animals, as they are the only type of livestock that may be marketed at top prices off pasture. Since the United States market for sheep meat is largely on a lamb basis, the more rapid development is definitely to their advantage and slow maturity a handicap from the standpoint of flock husbandry in the United States. Size or weight has been mentioned frequently as an important factor in selection. The birth weight, considered as a measure of growth during the prenatal life, should give an indication of ability to grow after birth.

The capability of a ewe to provide milk for her lamb varies from year to year, depending upon the environmental occurrences which influence the ewe and the lamb. These environmental occurrences may be widespread during prenatal or postnatal stages, and may influence the ewe only, the lamb only, or both the ewe and the lamb. Introduced and natural environmental factors operate to conceal genetic merit, thereby confusing the breeder and obstructing his efforts to select those animals having the greatest breeding value. Variations in environment can be eliminated or controlled except in some cases where adjustment or correction is necessary in placing lambs on an even basis.

The importance of evaluating the growth potentialities of lambs at an early age has long been recognized by the producer. The rate of growth in the early postnatal period is mainly governed by the amount of milk secreted by the ewe, but later the quality and quantity of pasture gradually take on more importance. It is of vital importance to study factors which might produce marked effects on the nutrition of growing lambs.

Weaning weight is important in lambs because it is the most economical practice for the lamb raiser to have his lambs sufficiently heavy and fat to sell when they have reached weaning age and it is soon after weaning that ewe lambs are selected to add to the breeding flock. Weaning weight is one of the measures of the producing ability of ewes. Many environmental factors can influence the performance of young lambs. More information on the factors that influence birth and weaning weight of lambs is needed to determine the effectiveness of selection based on these characters.

It is widely known that climatic factors have an important bearing on the physiological state of livestock. There is need of scientific research in the field of science that deals with the improvement of livestock in their ability to withstand climatic stress.

There is good reason to believe that rainfall and solar radiation can influence the nutrition and subsequently the birth and weaning weights of lambs. Information concerning this is limited.

The purpose of this paper was to present results of a study in which the relative importance of some of the factors that influence birth weight, weaning weight and growth on pasture of the Columbia, Corriedale and Suffolk sired lambs in different years were compared.

REVIEW OF LITERATURE

Factors Regulating Birth Weights

Birth factors is a collective term used to designate type of birth, time of birth and birth weight. The determination of time of birth may be partly controlled by genetic factors, insofar as the time of onset of oestrus is concerned.

Foster (1926), in work at Missouri, found the average birth weight of Shropshire rams to be 9.7 pounds while the ewes averaged 9 pounds. Hampshire rams average birth weight was 10.8 pounds compared to 9.6 pounds for the ewes. This report showed the ram lambs average birth weight was heavier than the ewe lambs.

Bell, Spencer, and Hardy (1936) observed that the average birth weight of American Merino lambs for 1929-1931 ranged from 8.16 pounds to 9.36 pounds with an average for all years of 8.72 pounds. They reported that Tasmanian Merino lambs ranged from 7.59 pounds to 8.58 pounds with an average of all years at 7.97 pounds.

Phillips, Stoehr and Brier (1940) observed that single Corriedale and Rambouillet lambs were larger than twins at birth. Single ram lambs were heavier at birth than single ewe lambs. A comparison of twin ram lambs with twin ewe lambs indicated that rams were slightly heavier than ewes. In 1938 the single Corriedale males averaged 10.5 pounds compared with 9.9 pounds for the single ewe lambs. The twin males averaged 8.8 pounds compared with 8.5 pounds for the twin ewe lambs. In 1939 the Corriedale ram lambs averaged 10.4 pounds compared to 9.9 pounds for

the single ewe lambs. The twin ram lambs averaged 9.9 pounds compared to 9 pounds for the twin ewe lambs. The 1938 Rambouillet single males averaged 10.6 pounds at birth compared to 9.7 pounds for the single ewes. The twin males averaged 9.2 pounds compared to 8.2 pounds for the twin ewe lambs. The 1939 Rambouillet single males averaged 10.2 pounds at birth compared to 9.1 pounds for the single ewes. The twin males weighed 8.6 pounds compared to 8 pounds for the twin ewe lambs.

Stoehr (1940) found similar differences between singles and twins of Corriedale, Columbia, Rambouillet and Targhee, and that the twins had a tendency to gain on the singles but never reached the same weight level.

Phillips and Dawson (1940) found similar differences in the Hampshire, Shropshire and Southdown breeds. *Early lambs were preferred to late lambs and lambs heavy at birth to lighter lambs. These effects of birth factors are considered to be mostly environmental in nature with undesirable influence on the selection of genetically superior lambs. There was little difference in survival between single lambs and twin lambs. The early lambs had a higher rate of survival than the late lambs. A significantly higher proportion of the lambs that were heavy at birth survived than of the light lambs. Type of birth, time of birth and birth weight were all related to weights of lambs at three months. A higher percentage of males were most pronounced in the Southdown breed. The deviation from the expected ratio was not significant statistically.

The relative importance of genetic makeup and environment on the development and growth of an animal varies with the conditions under which animals are raised and maintained. Phillips and Spencer (1948)

*Lambs dropped during the first half of the lambing period.

reported that the birth weight of Southdown lambs had a range of 7.31 pounds to 8.22 pounds at Middlebury, Vermont, during 1910, '11, '15, and '16 while at Beltsville, Maryland, they ranged from 7.05 pounds for two-year old ewes to 9.73 pounds for seven-year old ewes. During 1936-1943 they ranged from 5.66 pounds for two-year old ewes to 8.60 pounds for seven-year old ewes at Beltsville. At Middlebury they ranged from 6.12 pounds for two-year old ewes to 7.88 pounds for seven-year old ewes. No significant difference in average birth weights between Middlebury and Beltsville was indicated.

Kincaid (1943) in a study of 1800 lambs born over a 14 year period found birth weight to be one of the factors that influenced survival and growth. A significantly greater proportion of the lambs that were heavy at birth survived than those lighter at birth. Male lambs born as twins were slightly heavier than females, but the difference was small and relatively unimportant. Hampshire rams sired lambs averaging 1.05 pounds heavier than those sired by Southdown rams, the difference being highly significant. The estimate of the experimental difference associated with breed of sire is about 11 percent and indicates that the sire's influence on lamb birth weights is not slight.

In a comparison of birth weights on ten different kinds of breeding, Kean and Henning (1949) indicated that the Dorset x (Corriedale-Merino) Cross was the largest at birth followed closely by the pure-bred Hampshire and Hampshire x (Dorset-Merino) cross. The Southdown x (Dorset-Merino) and Hampshire x (Corriedale-Merino) were close behind. The Southdown crosses were smaller at birth. They found that all males

averaged 8.9 pounds compared to 8.3 pounds for females. All single lambs averaged 9.1 pounds for the ten year comparison, and all twins averaged 7.7 pounds. This study shows that the traits of twinning cannot be attributed to any one breed in particular, but it tends to show that this is an individual trait rather than a breed characteristic.

Blunn (1945) reported that a comparison of the birth weights of Navajos and crossbred lambs showed the crossbreds were heavier in three of the four years studied, while the two groups weighed the same in one year. The Navajos ranged from 7.3 pounds in 1940 to 7.9 pounds in 1939, while the crossbreds ranged from 7.8 pounds to 8.8 pounds. The variance between years was slightly greater for the Navajos than that of the crossbred lambs.

Blunn (1944), in a study of birthweights of Navajo lambs, reported only slight differences between the mean birth weights for the four years studied. The birth weights ranged from 7.7 pounds to 8.1 pounds. There was no significant difference between the mean birth weights for lambs having the same sires and dams, or the same sires but different dams.

Gregory, Blunn, and Baker (1950) found a significant difference in birth weight between sexes of Hereford calves sired by purebred bulls and out of high-grade Hereford dams. The heavier calves at birth seemed to maintain this advantage and weigh more at weaning. The differences between sires were significant at the .05 probability level for birth weight.

Phillips and Dawson (1937), in a study of 829 Southdown lambs, reported that a significantly higher number of the early male lambs survived than of the late lambs. The difference between the early and late female

lambs is in the same direction but is too small to be significant. The difference between the heavy male lambs at birth and the light males at birth surviving to three months was highly significant. The difference between the heavy and light female lambs is in the same direction but is too small to be significant. Weight at birth and date of birth were both found to be significantly associated with weight at three months of age. It was shown that single lambs, early lambs, and heavy birth weight lambs have been favored over the twin, late and light lambs respectively, even though no conscious effort was made to favor any of these groups. Two hundred twenty-nine single male lambs averaged 8.45 pounds at birth compared to 8.03 pounds for one hundred ninety-four single female lambs. The 230 twin males averaged 6.96 pounds compared to 6.58 pounds for 176 twin female lambs.

A relationship between birth weight and survival was reported in swine by Cole and Kuhlman (1929).

Phillips (1928) reported that low or high birth weights was no measure of the rate of growth in lambs. The average birth weight of ram lambs was nearly one pound above that of ewe lambs in Welsh Mountain lambs, and about one-half pound in the Kerry lambs. The single ram lambs were heavier at birth than single ewes and the twin rams and the single ewes were heavier than the twin ewes. In most cases the heaviest lambs were born later than the peak week in the lambing seasons, but the lowest birth weights were not restricted to any particular period. This study indicated that lambs born from the middle of February to the middle of March were higher in average birth weight in all cases.

Blunn (1942) reported significant differences in birth weights of single and twin ewe lambs. Significant differences in single and twin ram lambs did not begin until one month of age. These differences were probably caused by lack of range forage for the ewe and lamb.

Growth, Weaning Weight and Influence of Environmental Factors

From the practical farmer's point of view, the rate of growth in weight during the early life of the lamb is more important than birth weight. The rate of growth in lambs is dependent on a variety of factors, the main one being the milk yield of the ewes, which depends largely upon nutrition. The differences in the level of milk production of ewes has a marked influence on the early post-natal growth rate of lambs, mainly up to six weeks of age. Weather conditions, families, breed or crossbreed, age of ewes, undoubtedly influence the rate of growth made by individual lambs.

Phillips (1928) reported a very wide variation in the rate of growth of individual lambs. He found a difference in the rate of growth in favor of single lambs over twin lambs. A scarcity of pasture might account for big differences. Ewe lambs were not able to make up for their disadvantage in birth weight. Twin ewe lambs eventually attained the same weight as single ewe lambs. These weights were over 10 pounds less than the average for rams by August 16. The rate of growth of twin ram lambs was rapid as their rate was just below that of single rams. The rate of growth for all lambs dropped off rapidly after the first four months of age.

The rate of gain of lambs from birth to weaning is not only a measure of growth but indirectly a measure of milk production by the dam. Bell, Spencer, and Hardy (1936) reported that there was little difference between American Merino and Tasmanian Merino lambs average rate of gain from birth to weaning. Milk production by the ewes of the two breeds must have been comparable.

Phillips and Dawson (1937) reported a significant association between date of birth and birth weight with weight of lambs at three months of age. The work of Kincaid (1943) bears out this relationship of birth weight to weight at three months but with less definite relationships at later stages.

Other workers have found a positive correlation between birth weights in swine, sheep and cattle and following weights in the growing period.

Phillips, Stoehr, and Brier (1940) observed a decrease in the rate of growth of Corriedale and Rambouillet lambs at twenty to thirty weeks of age supposedly caused by weaning and movement to new range pasture. Rams gained faster than ewes to weaning and with supplemented feeding gained much more rapidly after weaning. The ewe lambs failed to continue normal gains after weaning largely due to drouthy pasture and emphasized the need for supplemental grain feeding. This was supported by ram gains under such a feeding program. There was a difference in the rate of growth in the seasons observed as would be expected since the range feed supply varies with weather conditions. Body weights on these lambs were obtained at two-week intervals from birth to one year of age.

In a study of weights on Navajo lambs at 28 day periods from birth to weaning, Blunn (1942) reports significant differences between the mean monthly weights for the several years studied. The variance between years was greater than that within years. The yearly differences were probably related to range forage conditions.

Blunn (1944), reports that differences between mean weights of Navajo lambs at four to twenty weeks of age were greater than those present at birth and were highly significant. There were also significant differences between the several years studied. Uncontrolled environmental factors were believed mostly responsible for causing the differences in weights observed between the years.

Simmons (1944), reported that the Karakul and crossbred lambs were smaller than the Hampshire and larger than the Southdown lambs at any age from birth to 52 weeks. Differences between breeds in the average birth weights were adjusted with the Karakul showing greatest similarity to Corriedale lambs in rate of growth, followed by the Shropshire, Southdown, and Hampshire breeds. The Karakul x Corriedale lambs ranked in the same order as the Karakul with respect to similarity in rate of growth.

Phillips and Dawson (1940) reported that the relative time of birth as compared to the weights at six and twelve months indicate that the effect of time of birth on birth weight tends to disappear as the animal matures. The effect of birth weight is similar to that of time of birth in that it has a definite relationship with weight at three months and a less marked effect at later stages. The effect of sex on weights at

3, 6, and 12 months of age apparently differs from the effects of the other two factors discussed in that the difference between the sexes becomes more pronounced as the animals mature.

Blunn (1945) found that yearly differences had a greater effect on growth on the crossbred lambs than they had on the Navajos. He expected the crossbreds to be more variable than the Navajos within any year which they were. The different reactions to environment caused the varied effect on growth. The Navajos had 400 years in which to become adapted to the area.

Hazel and Terrill (1945) found that Rambouillet ram lambs were 8.3 pounds heavier than ewes at weaning time and that singles were 9.2 pounds heavier than twin lambs. These figures are about 2.5 pounds less than corresponding differences in the Columbia, Corriedale and Targhee breeds as reported by Hazel and Terrill (1946). The effects of sex, age of dam, and type of birth on weaning were highly significant. Lambs were gaining at an average rate of more than 0.4 pounds per day at weaning age. The average weight of 69 pounds at 124 days of age was heavier than some studies so that a higher rate of gain per day may be expected.

In an investigation of 1,506 lambs sired by Columbia, Corriedale, Crossbred, Navajo, and Romney rams on Navajo ewes, Sidwell and Grandstaff (1949) reported the unadjusted average weaning weight to be 59.4 pounds at 139 days of age. Columbia rams sired the heaviest lambs at weaning, followed by Corriedale, Crossbred, Navajo, and Romney rams. Ram lambs averaged 4.4 pounds heavier than ewes at weaning and single lambs were 11.2 pounds heavier than twins.

Correlation coefficients for the weights of calves at weaning and the weights of the cows at weaning and birth weight with weaning weight were highly significant at the Nebraska Experiment Station as reported by Gregory, Blunn, and Baker (1950).

Phillips (1936) in a study of growth of 110 Shropshire lambs, showed that lambs with a birth weight under 8 pounds weighed 51.3 pounds at 4 months of age where the lambs with a birth weight over 8 pounds weighed 59.6 pounds at 4 months.

In a comparison of Rambouillet and Corriedale breeds under strictly range conditions, Jones, Dameron, Warwick, and Davis (1940), reported average weaning weights of 62.8 pounds for Rambouillet lambs and 54.8 pounds for Corriedale lambs. They observed that the Rambouillet had body weight advantages at all ages over the Corriedale.

Effect of rainfall on growth. Differences in rate of growth between two pasture seasons have been observed. These differences would be expected where the animals are raised under range conditions with the feed supply dependent on weather conditions. It is known that range forage is dependent upon the amount and time of precipitation, and that the amount of forage largely determined the growth made by the lambs. Blunn (1944) reported that during 1938 to 1940 drouth conditions prevailed at the Southwestern Range and Sheep Breeding Laboratory, while the amount of moisture received in 1941 was considerably above average. The lambs weighed in 1941 were not only heavier but they were thriftier than those of previous years. The differences were attributed to the increased rainfall.

A correlation coefficient between growth of lambs and May rainfall proved highly significant as reported by Singh (1953). This also showed that in years of high rainfall growth had a tendency to decrease. Correlation coefficients between June and July rainfall and weaning weights were not significant showing that the rainfall during this period did not have a noticeable influence on weaning weights of lambs.

Effect of solar radiation on growth. Singh (1953) observed that during years of above average rainfall in May and June, lamb growth was below average indicating that probable cold weather accompanied the above average spring rainfall causing more pneumonia and unthrifty lambs than during years of less rainfall. The foggy cloudy atmosphere accompanying the excessive rainfall would seem to affect the amount of solar radiation absorbed by soils affecting the vegetation produced followed by lowered growth in lambs.

Absorption of solar energy by the earth's atmosphere is not very effective. To most of the wave lengths in the solar beam the atmospheric gases are transparent. Those gases that do absorb are selective in their action, absorbing more in some wave lengths than in others. Water vapor is the controlling agent in the atmospheric absorption, although oxygen, ozone, and suspended particles, such as dust and cloud droplets, play a minor part according to Trewortha (1943).

A part of the solar energy which is scattered and reflected by the atmosphere and the earth's surface is sent back into space and is lost to the earth. The amount of depletion of sun energy by scattering, reflection, and absorption in passing through the atmosphere depends upon

(a) the length of the passage, or, in other words, the angle of the sun's rays; and (b) the transparency of the atmosphere.

Riemerschmid (1943) observed that the total amount of radiation absorbed by the body surface of cattle during a clear mid-summer day was 20,000 kilogram calories. A comparison of the total amount of radiation absorbed by the hairy coat and the heat produced by metabolism showed that cattle absorbed nearly three times as much heat from radiation as they produce by metabolism during an equal period. Natural or artificial shade will reduce the amount of heat absorbed by the hairy coat of cattle to 30-40 percent of the amount which radiates on to the animal in the open.

Color is the most important factor affecting the absorptivity of hairy coats for solar radiation, and the direction of the hair, smoothness or curliness and seasonal changes in the character of the coat are of secondary importance according to Riemerschmid and Elder (1945).

The amount of solar radiation might have some effect on the controversial shearing of lambs versus not shearing for better gains.

ANALYSIS OF DATA

Source of Data

The data used in this study were obtained from the Michigan State College Experimental Ewe and Lamb Flock. The project records were kept for 1952 through 1954.

The 1952 lambs used in the study were sired by purebred Suffolk rams and were out of three-year old western ewes. The 1953 lambs were sired by purebred Suffolk and Columbia rams and approximately two-thirds of the dams were four year old western ewes with the remaining one-third being Montana yearlings. The 1954 lambs were sired by purebred Columbia and Corriedale rams and the dams were the same used in 1953. One of the 1952 sires was used in 1953 and the 1953 Columbia ram was the same for 1954. The rams were turned with the ewes about the last of October in 1951-2 and a week later in 1953. The lambs were born during the last of March and the first three weeks of April except for 1954 when they were dropped a week later. The lambs were weighed and a record of weight, sex, date and breed was made within 24 hours after parturition. The number of birth weights collected and studied were 75, 103, and 102 for 1952, 1953 and 1954 respectively.

The lambs studied on the eight pasture plots were lotted at random with the purpose in mind of balancing the lots according to weight, type of birth, sex and breed. Only apparently normal, thrifty individuals were used in the experiment. The 1952 ewes and lambs were weighed and

turned to pasture on May 15 and the lambs were weaned on August 7. The 1953 ewes and lambs were weighed and turned to pasture on May 11 and the lambs weaned on August 4. The 1954 ewes and lambs were weighed and turned to pasture on May 18 and the lambs weaned on July 13. The ewes and lambs were weighed at two week intervals until weaning and the method of securing the weights was held as constant as possible. The ewes and lambs were given sufficient forage and the number of animals was adjusted for each pasture plot where necessary to allow for sufficient forage to be available. This pasture work was done in conjunction with the Farm Crops Department of Michigan State College.

The data for the climatic conditions studied for the years 1952-53 were obtained from the Cultivated Watershed and Hydrologic Research Station - a cooperative project of the Michigan Agricultural Experiment Station and the Division of Research, Soil Conservation Service, United States Department of Agriculture located at Michigan State College.

Factors Affecting Birth Weights

The growth of the lambs for the intra-uterine era was measured by the birth weight. The data on birth weight were taken only for the lambs born alive. The birth weights were taken within a 24-hour period after parturition.

TABLE 1

NUMBER AND UNCORRECTED MEAN BIRTH WEIGHT OF LAMBS
BY BREED OF SIRE AND YEAR

Year	Breed of Sire	Number of Single Lambs	Birth Mean Weight	Number of Twin Lambs	Mean Weight Birth
1952	Suffolk	71	11.19	4	7.12
1953	Suffolk	33	11.43	18	8.51
1953	Columbia	38	10.78	14	8.25
1954	Columbia	33	11.65	21	8.69
1954	Corriedale	28	11.29	20	8.45

A direct comparison of the weights of the Suffolk sired lambs shows the lambs of 1953 were slightly heavier. The small number of twin lambs for 1952 was believed to be due to the condition of the ewes at breeding time. The 1954 Columbia sired lambs were heavier than the Corriedale sired and the 1953 Columbia lambs. There was greater variation in the mean birth weight of the single Columbia lambs than the other breeds except that of the Suffolk twins which is probably due in part to lack of numbers in 1952. The single Columbia sired lambs of 1954 had the heaviest mean birth weight recorded. In all of the crossbreds it will be observed that the singles were larger than the twins at birth. The mean weight of the 1952 single Suffolk males was 11.20 pounds as compared to 11.18 pounds for the single ewe lambs. The mean weight of the 1953 single Suffolk males was 11.80 pounds as compared to 11.14 pounds for the single ewe lambs. The mean weight of the 1953 single Columbia males was 11.42 pounds as compared to 10.44 pounds for the single ewe

lambs. The mean weight of the 1954 single Columbia males was 12.21 pounds as compared to 11.24 pounds for the single ewe lambs. The mean weight of the 1954 single Corriedale males was 11.59 pounds compared to 11.09 pounds for the single ewe lambs. The 1954 single Columbia ram lambs had the heaviest mean birth weight recorded.

The study shows that in 280 lambs of the 3 breeds used, the average birth weight was 10.47. The average birth weight of 112 ram lambs was 10.70 pounds; 168 ewe lambs, 10.31 pounds; 77 twins, 8.43 pounds; and 203 single lambs, 11.24 pounds. The ram to ewe ratio was 40 percent to 60 percent with twins to singles ratio 27.5 percent to 72.5 percent.

The analysis of variance given in Table 2 follows the method given by Snedecor (1950).

TABLE 2

ANALYSIS OF VARIANCE OF BIRTH WEIGHT OF 1952 AND 1953 SINGLE SUFFOLK SIRED LAMBS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Value
Total	103	197.91		
Year	1	1.31	1.31	.678
Error	102	196.60	1.93	

The analysis of variance of the birth weight of the 1952 and 1953 single Suffolk lambs was made as shown in Table 2. Here, the F-test did not show any significant difference in the average birth weights of

the 1952 single Suffolk lambs and those of 1953 indicating that there was no significant year to year difference in the average birth weights of single Suffolk lambs.

TABLE 3

ANALYSIS OF VARIANCE OF BIRTH WEIGHT OF 1953 SINGLE COLUMBIA AND SUFFOLK SIRED LAMBS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Value
Total	70	190.72		
Breeds	1	7.59	7.59	2.86
Error	69	183.13	2.65	

The analysis of variance of the birth weight of the 1953 single Columbia and Suffolk lambs was made as shown in Table 3. The F-test did not show any significant difference in the average birth weight of the single Columbia and Suffolk sired lambs for 1953.

TABLE 4

ANALYSIS OF VARIANCE OF BIRTH WEIGHT OF 1953 TWIN COLUMBIA AND SUFFOLK SIRED LAMBS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Value
Total	31	51.74		
Breed	1	.55	.55	.322
Error	30	51.19	1.71	

The analysis of variance of the birth weight of the 1953 twin Columbia and Suffolk lambs was made as shown in Table 4. The F-test did not show any significant difference in the average birth weight of the twin Columbia and Suffolk lambs for 1953.

Effect of Rainfall on Lamb Growth

The influence of concurrent rainfall, rainfall for one week before and one week of the growth period, and rainfall for the two week period prior to the growth period has been determined for 1952 and 1953. It would seem that rainfall, indirectly through the vegetation, could affect lamb gains over the respective weight periods.

The degree of relationship between the two variables - rainfall and growth was determined by correlation and regression between concurrent rainfall and growth for each lot for 1952 and 1953 are presented in Tables 5 and 6 respectively. The values for the two years were not significant statistically. The rainfall for 1952 was less than that for 1953 by 2 inches. The rainfall during 1953 was more evenly distributed during the pasture study. The 1953 correlation coefficients were negative values except for one lot. The 1952 correlation coefficients were all positive and showed a tendency toward a relationship.

The coefficients of correlation and regression between rainfall for one week before and the first week of the growth period for each pasture lot for 1952 is shown in Table 7. The values were not significant statistically and there was less relationship found than for the concurrent rainfall. Because of the very low relationship found then for the concurrent rainfall on the growth in 1953, this relationship of rainfall

one week before and one week of the growth period was not undertaken. Table 8 shows the coefficients of correlation and regression for totals of the lambs on pasture for 1952 and 1953. These figures were not significant statistically.

The coefficients of correlation and regression between rainfall for the two week period prior to the growth period of each pasture lot for 1952 and 1953 are shown in Tables 9 and 10 respectively. The amount of rainfall between the two years for the pasture study was approximately the same. The 1953 figures again showed negative except for lot 2 and the 1952 figures were positive but showing less of a trend toward a significant correlation than the concurrent rainfall on growth for 1952.

The previous coefficients of correlation and regression were determined by using the actual rainfall for the two week weigh period with an average gain for all the lambs in the lot for the corresponding two week weigh period. The coefficients of correlation and regression of concurrent rainfall on growth for lot 1 of 1952 as shown in Table 11 was determined by correlating the rainfall for each two week weigh period with that of each lamb's gain for each of the 6 weigh periods. The correlation and regression coefficients of .656 and 2.033 respectively are highly significant statistically.

The following formula was used to correct for the error in correlation and regression coefficients in rainfall and lamb growth due to the time element involved. The error of the correlation of time and gain correlated with the error for time and rainfall gave no significant correlation.

$$y = a + bx + cx^2$$

The correlation and regression coefficients for the correction data are shown in Table 12.

The correction coefficients of 0.048 and 0.171 for correlation and regression respectively are not statistically significant.

TABLE 5

CORRELATION AND REGRESSION COEFFICIENTS OF LAMB GROWTH
ON CONCURRENT RAINFALL, 1952

Lot	D.F.	Sum of Square and Products			r	b
		Sx^2	Sxy	Sy^2		
1	4	6.10	13.27	48.41	0.772	2.175
2	4	6.10	12.62	65.20	0.633	2.069
3	4	6.10	12.56	71.06	0.603	2.059
4	4	6.10	9.21	65.21	0.462	1.510
5	4	6.10	10.92	74.02	0.514	1.790
6	4	6.10	11.14	52.83	0.621	1.826
7	4	6.10	14.83	69.12	0.722	2.431
8	4	6.10	8.74	47.89	0.511	1.433

TABLE 6

CORRELATION AND REGRESSION COEFFICIENTS OF LAMB GROWTH
ON CONCURRENT RAINFALL, 1953

Lot	D.F.	Sum of Squares and Products			r	b
		Sx^2	Sxy	Sy^2		
1	4	8.12	-0.78	25.89	-0.054	-0.096
2	4	8.12	-5.60	27.68	-0.374	-0.690
3	4	8.12	-0.99	59.79	-0.045	-0.122
4	4	8.12	1.24	31.24	0.078	0.153
5	4	8.12	-2.84	45.00	-0.148	-0.350
6	4	8.12	-6.50	58.57	-0.298	-0.800
7	4	8.12	-0.89	32.36	-0.055	-0.110
8	4	8.12	-0.21	30.71	-0.013	-0.026
All Lots (ave.)		8.12	-1.46	38.39	-0.083	-0.180

TABLE 7

CORRELATION AND REGRESSION COEFFICIENTS OF LAMB GROWTH ON RAINFALL ONE WEEK BEFORE AND ONE WEEK DURING GROWTH, 1952

Lot	D.F.	Sum of Squares and Products			r	b
		Sx2	Sxy	Sy^2		
1	4	5.95	6.44	48.41	.379	1.082
2	4	5.95	8.24	65.20	.418	1.385
3	4	5.95	8.54	71.06	.415	1.435
4	4	5.95	6.74	65.21	.342	1.133
5	4	5.95	7.44	74.02	.355	1.250
6	4	5.95	4.74	52.83	.267	.797
7	4	5.95	3.71	69.12	.183	.624
8	4	5.95	8.14	47.89	.482	1.368

TABLE 8

CORRELATION AND REGRESSION COEFFICIENTS OF LAMB GROWTH ON RAINFALL FOR ONE WEEK BEFORE AND ONE WEEK DURING GROWTH

Year	D.F.	Sum of Squares and Products			r	b
		Sx^2	Sxy	Sy^2		
1952	4	5.95	6.75	56.93	0.367	1.134
1953	4	1.77	.41	38.39	0.049	.232

TABLE 9

CORRELATION AND REGRESSION COEFFICIENTS OF LAMB GROWTH ON RAINFALL FOR TWO WEEK PERIOD PRIOR TO WEIGHTS, 1952

Lot	D.F.	Sum of Squares and Products			r	b
		Sx^2	Sxy	Sy^2		
1	4	6.08	3.89	48.40	.227	0.640
2	4	6.08	5.75	65.20	.289	0.946
3	4	6.08	7.40	71.06	.356	1.217
4	4	6.08	4.64	65.21	.233	0.762
5	4	6.08	4.55	74.02	.214	0.748
6	4	6.08	2.99	52.83	.167	0.491
7	4	6.08	.87	69.12	.042	0.143
8	4	6.08	5.14	47.89	.301	0.845

TABLE 10

CORRELATION AND REGRESSION COEFFICIENTS OF LAMB GROWTH ON RAINFALL FOR TWO WEEK PERIOD PRIOR TO WEIGHTS, 1953

Lot	D. F.	Sum of Squares and Products			r	b
		Sx^2	Sxy	Sy^2		
1	4	6.33	-0.47	25.89	-0.037	-0.074
2	4	6.33	3.11	27.68	0.235	0.491
3	4	6.33	-6.28	59.79	-0.323	-0.992
4	4	6.33	-4.82	31.24	-0.343	-0.761
5	4	6.33	-2.59	45.00	-0.153	-0.409
6	4	6.33	-0.26	58.57	-0.013	-0.041
7	4	6.33	-4.01	32.36	-0.280	-0.633
8	4	6.33	-5.16	30.71	-0.370	-0.815

TABLE 11

CORRELATION AND REGRESSION COEFFICIENTS OF CONCURRENT RAINFALL ON LAMB GROWTH FOR LOT 1, 1952

Year	D. F.	Sum of Squares and Products			r	b
		Sx^2	Sxy	Sy^2		
1952	52	54.87	119.56	605	.656*	2.033

* Significant at 1 percent level.

TABLE 12

CORRELATION AND REGRESSION COEFFICIENTS FOR THE CORRECTION DATA

Year	D. F.				r	b
		Sx^2	Sxy	Sy^2		
1952	52	14.51	2.48	185.33	0.048	.171

Effect of Solar Radiation on Lamb Growth

Correlation and regression coefficients were determined for solar radiation with lamb growth on pasture. The variable solar radiation was measured in gram calories and the average gain for each two week weigh period was taken for lamb growth.

Lots 1 and 2 of 1952 and 1953 respectively were chosen for this study because of the highest correlation between these and rainfall. An average of all gains for the various two week weigh periods was used for the study of all the lambs for the two years.

There was no statistical significance in the coefficients studied. It should be pointed out that there was more solar radiation for the year 1952 which had the least amount of rainfall for the particular days that the experiment covered.

Table 13 shows the correlation and regression coefficients of lamb growth on solar radiation.

Weight Associations

In this study unadjusted weights were used in determining correlation and regression coefficients for birth weight with weaning weight, and weaning weight of the lambs with weight of ewe at weaning time. The latter was studied by breed of sire and the former by breed of sire except for 1953 when all lambs were analyzed together.

Table 14 shows the correlation and regression coefficients of birth weight of lamb on weaning weight. The 1952 Suffolks, all 1953 lambs, 1954 Columbia and Corriedales showed statistically significant correlation coefficients between birth weight and weaning weight.

TABLE 13

CORRELATION AND REGRESSION COEFFICIENTS OF LAMB GROWTH ON SOLAR RADIATION

Year	Lot	D.F.	Sum of Squares and Products			r	b
			Sx^2	Sxy	Sy^2		
1952	All	4	10.86	.22	2.42	.043	.020
1952	1	4	3963899.5	593.32	48.41	.043	.0001
1953	2	4	1483456.	573.8	27.68	.089	.0004
1953	All	4	1483456.	739.78	38.39	.098	.0005

TABLE 14

CORRELATION AND REGRESSION COEFFICIENTS OF BIRTH WEIGHT OF LAMB AND WEANING WEIGHT OF LAMB

Year	Breed of Sire	D.F.	Sum of Squares and Products			r	b
			Sx^2	Sxy	Sy^2		
1952	Suffolk	52	84.97	275	4407.5	.449*	3.236
1953	All	84	282	823	8123	.544*	2.918
1954	Columbia	29	120	140.3	748	.468*	1.169
1954	Corriedale	27	120.55	435	2840	.744*	3.608

*Significant at 1 percent level

The correlation and regression coefficients of weaning weights and the weight of the ewe at weaning time are shown in Table 15. The correlation coefficients of the 1952 and 1953 Suffolks for weaning weight and the weight of the ewe at weaning time shows a statistical significance. The correlation coefficients of the 1953 and 1954 Columbia and the 1954 Corriedale are not significant statistically although the 1954 Columbia coefficient shows a definite trend. The 1954 Columbia lambs were weaned one month earlier than the 1953 lambs and at this earlier date the lambs were lighter and the ewes heavier than those of 1953. The difference between the 1953 Columbia and Suffolk lambs is probably due in part to a difference in the two sires. The relatively few twins in the 1952 lambs may have had a bearing on the highly significant correlation, however, the 1953 Suffolk lambs studied had the same number of single rams, single ewes and twins as those in the 1953 Columbia study and the average weight of the ewes at weaning time were within two pounds of those for the Columbia sired lamb's dam.

TABLE 15

CORRELATION AND REGRESSION COEFFICIENTS OF WEANING WEIGHT OF LAMB AND WEIGHT OF EWE AT WEANING

Year	Breed of Sire	D.F.	Sum of Squares and Products			r	b
			Sx^2	Sxy	Sy^2		
1952	Suffolk	52	4407	1936	5169	.406[a]	.439
1953	Suffolk	35	3139	1405	3700	.412[b]	.447
1953	Columbia	32	2446	541	5328	.150	.221
1954	Columbia	32	886	730	5572	.328	.824
1954	Corriedale	27	2841	1031	4753	.281	.363

[a] Significant at 1 percent level

[b] Significant at 5 percent level

Growth of Lambs on Pasture

The growth of lambs in this study was measured by the weights taken at the two week intervals until weaning and followed for a month past the weaning weight with the exception of 1954 when the lambs were weaned a month earlier than usual. The daily gain was computed for each two week interval and for the total pasture study for each lamb for each of the three years studied. In many studies growth is first measured by a weaning weight taken at approximately four months of age. Market lambs and breeding replacements are often selected on the basis of this first and only weight.

After six or eight weeks the ewe's milk becomes of less importance and the amount and quality of the pasture takes on greater importance. This is of a more or less gradual nature. The ultimate growth of lambs is best reached by the use of plants that are succulent, palatable, nutritious and in an active growing condition. This alone makes it a worthwhile project to study the indispensables in regards to pasture growth.

The average lamb gains in pounds and the average daily gain in pounds for each two week weigh period for the 3 years studied is shown in Table 16. The early gains in all 3 years were high with a lowered trend toward the weaning date. The 1954 lambs were weaned 28 days earlier than those of 1952 and 1953 because it was suspected that the 1952 and 1953 lambs were marking time a month prior to weaning with average daily gains of .168 and .179 pounds. The 1954 lambs showed an average daily gain of .403 pounds directly following the early weaning period.

TABLE 16

AVERAGE LAMB GAIN AND AVERAGE DAILY GAIN ON PASTURE
FOR THREE YEARS STUDIED

Year	Two Week Weighing Periods							
	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth
1952	12.00 .857	8.01 .534	6.94 .496	5.94 .425	2.50 .179	3.69 * .264*	2.24 .160	2.75 .196
1953	9.58 .639	7.50 .535	6.01 .429	6.07 .433	2.76 .197	2.35 * .168*	3.42 .244	3.18 .227
1954	9.83 .702	7.08 .506	5.24 .349	2.92 * .224*	5.65 .403	2.96 .228	1.42 .095	1.19 .092

*Denotes weaning time

Data showing the results of an analysis of the growth in body weight of the lambs by breed of the sire and for each year while on the pasture experiment is presented in Table 17. The breed indicates that of the sire as the dams were all western ewes. The 1952 lambs had a heavier average starting weight for the pasture experiment than the lambs of other years probably due to the few twins in 1952 and sire difference. The 1952 lambs went to pasture a week earlier than the 1954 lambs and four days earlier than those of 1953. The 1952 lambs had the largest average daily gain with .468 pounds per day while on the pasture until weaned. This follows the findings of others that heavier starting lambs make larger daily gains on pasture. The 1953 lambs were lighter at the start of pasture feeding probably due in part to the condition of the ewes at lambing. They gained well, with the Suffolk sired lambs having the second highest average daily gain for the three month pasture period. The 1953 Columbia sired lambs had the lowest average daily gain for the pasture experiment.

The analyses of covariance which were carried out for the data contained in Table 17 were used to calculate the relative importance of differences between years in causing variations in pasture growth between the 1952 and 1953 Suffolk sired lambs. These results are presented in Table 18 where the differences between the pasture growth were not statistically significant. The analysis of covariance was used to calculate the relative importance of differences between sires in causing variations in pasture growth in the 1953 lambs as shown in Table 19, and also differences between sires in causing variations in pasture growth

TABLE 17

LAMBS AVERAGE STARTING AND WEAN WEIGHTS, TOTAL GAIN TO WEAN, DAILY GAIN WHILE ON THE 1952-1954 PASTURE EXPERIMENT

Year	Breed of Sire	No. of Lambs	Average Starting Weight on Pasture	Average Weaning Weight	Average Daily Gain to Wean	Average Total Gain for Three Months Pasture	Average Daily Gain for Three Months Pasture	Average Weight at End of Three Months Pasture
1952	Suffolk	54	32.61	72.17	.468	39.76	.468	72.17
1953	Suffolk	38	25.26	62.20	.434	36.90	.434	62.20
1953	Columbia	38	23.29	55.39	.378	32.10	.378	55.39
1954	Columbia	32	27.16	52.47*	.452	34.94	.421	62.03
1954	Corriedale	30	26.90	52.10*	.450	32.67	.394	59.57

*Weaned 28 days earlier than other years

TABLE 18

ANALYSIS OF COVARIANCE OF INITIAL PASTURE WEIGHT AND PASTURE GAIN OF 1952 AND 1953 SUFFOLK SIRED LAMBS

Source of Variation	D.F.	Sum of Squares x^2	Mean Square	Sum Product xy	Sum of Squares y^2	Mean Square	Adjusted Sum of Squares	D.F.	Adjusted Mean Square	F
Total	91	5031		1025	2725					
Between Year Average	1	1205	12.05	465	180	180				
Within Year Averages	90	3826	42.5	560	2545	28.3	2463	89	27.7	2.06
Error + Year	91	5031		1025	2725		2520			
Year							57	1	57	

TABLE 19

ANALYSIS OF COVARIANCE OF INITIAL PASTURE WEIGHT AND PASTURE GAIN OF 1953 SUFFOLK AND COLUMBIA SIRED LAMBS

Source of Variation	D.F.	Sum of Squares x^2	Mean Square	Sum Product xy	Sum of Squares y^2	Mean Square	Adjusted Sum of Squares	D.F.	Adjusted Mean Square	F
Total	75	2743		662	2901					
Between Sire Averages	1	74	74	180	440	440				
Within Sire Breed Error	74	2669	37.4	482	2461	33.26	2374	73	32.5	11.32*
Error and Breed	75	2743		662	2901		2742			
Breed of Sire							368	1	368	

*Significant at 1 percent level

in the 1954 lambs as shown in Table 20. The analysis of covariance shows that there is a statistically significant difference between the initial weight and growth of Suffolk sired lambs and initial weight and growth of Columbia sired lambs while on the pasture study for 1953. Statistically significant differences between the initial weight and growth of Columbia sired lambs and the initial weight and growth of Corriedale sired lambs, while on the 1954 pasture study, were found. It appears that genetic factors played an important role in causing the differences in pasture growth of lambs within the years of 1953 and 1954.

The unadjusted average weaning weights and pasture gains are given in Table 21. The greatest weaning weight is shown for the 1952 Suffolk sired single ewe lambs. These lambs also had the greatest average pasture gain. The 1953 Suffolk sired lambs did not have the next heaviest weaning weight except in single ewes but their pasture growth was next to the 1952 Suffolk sired lambs. Except for the 1952 lambs, the single ram lambs were heavier than the single ewe lambs and the single ewes were heavier than the twins on an average basis. The pasture growth followed somewhat of the same trend except that the 1953 Suffolk sired single ewes gained more than the single ram lambs and the 1954 Columbia sired twins gained more on an average than the single ewe lambs. These are perhaps only an indication of a trend as few numbers were available for this study. The 1953 Columbia sired twins were all ewe lambs whereas in other years an approximate fifty-fifty ratio existed between the sexes. In the 1952 single lambs studied, 20 were males and 34 females; 1953 single Suffolk sired lambs, 11 males and 16 females; 1954 single

TABLE 20

ANALYSIS OF COVARIANCE OF INITIAL PASTURE WEIGHT AND PASTURE GAIN ON 1954 COLUMBIA AND CORRIEDALE SIRED LAMBS

Source of Variation	D.F.	Sum of Squares x^2	Mean Square	Sum Product xy	Sum of Squares y^2	Mean Square	Adjusted Sum of Squares	D.F.	Adjusted Mean Square	F
Total	65	1842		486	1010					
Between Breed Sire Averages	1	2	2	- 13	85	85				
Within Breed Error	64	1840	28.8	499	925	14.4	789.8	63	12.5	7.35*
Error and Breed	65	1842		486	1010		88.17			
Breed							91.9	1	91.9	

*Significant at 1 percent level

TABLE 21

UNADJUSTED AVERAGE WEANING WEIGHTS AND PASTURE GROWTH FOR LAMBS

Year	Breed of Sire	Wean Weights			Average Pasture Gain		
		Single Ram Lamb	Single Ewe	Twins	Single Ram Lamb	Single Ewe	Twins
1952	Suffolk	69.1	74.0	---	38.3	40.6	---
1953	Suffolk	64.3	63.2	58.2	37.1	37.4	36.0
1953	Columbia	60.8	57.9	47.2	34.8	32.5	29.9
1954	Columbia	64.9	62.1	59.8	35.6	34.7	35.1
1954	Corriedale	64.5	61.2	51.0	34.9	32.2	30.5

Columbia sired lambs, 8 males and 16 females; 1954 single Corriedale sired lambs, 10 males and 12 females comprised the study.

The average early Columbia sired lamb in 1954 weighed 54.4 pounds at weaning compared to 50.3 pounds for lambs dropped after the middle of the lambing period. This lambing period was about three weeks in length. The average pasture gain for the early lambs was 25.4 pounds compared to 25.8 pounds for the lambs born later in the season.

The average 1954 Corriedale sired early lamb weighed 53.7 pounds at weaning compared to 50.1 pounds for the lambs born later. The early lambs gained 25.7 pounds on pasture compared to an average of 24.5 pounds for the lambs dropped later in the season. The 1954 Corriedale sired lambs were born over a 16 day period.

With a 38 day lambing season, the 1953 Suffolk sired early lambs averaged 63.9 pounds at weaning compared to 57.4 pounds for the late lambs. The late lambs outgained the early lambs on pasture 39.1 pounds to 36.1 pounds. This may be due in part to lack of numbers. The 1953 Columbia sired early lambs averaged 58.4 pounds at birth compared to 52.9 pounds for the lambs dropped late. The early lambs outgained the late lambs 33.8 pounds to 31.0 pounds while on pasture.

An analysis of the 1952 Suffolk sired lambs with an early birth date showed a mean weaning weight of 77.7 pounds as compared to 67.0 pounds for the lambs dropped during the last half of the approximately 28 day lambing season. The mean gain on pasture for the early lambs was 40.7 pounds while that of the late lambs was 38.9 pounds.

SUMMARY AND CONCLUSIONS

Data on growth in lambs sired by purebred Suffolk, Columbia, and Corriedale rams and out of western ewes handled under farm flock conditions at the Michigan State College Experiment Station are presented. The prenatal growth was studied by birth weights and the lambs' growth on pasture analyzed by weighing each lamb at two week intervals and recording this information.

The effect of some environmental factors on growth was studied such as time of birth, type of birth, sex, year, weaning, existing climatic conditions, and breeding of sire. Data are also presented on the influence of birth weight on weaning weight and on weaning weight and weight of the ewe at weaning time.

1. The unadjusted mean birth weights of the single male lambs were heavier than those for single ewes in the three years studied and the twins unadjusted mean birth weight was less than the singles. The twin is hampered by having to share both uterine nutrients and space as well as milk supply of its dam after birth. The difference in the unadjusted average birth weights of the lambs from the crossbreeds may be considered as a breed difference, but it appears to have little significance. There was no significant difference between the birth weights of the 1952 and 1953 Suffolk sired single lambs. There was no significant difference for birth weights between the crossbred lambs within years.

2. The relative time in the lambing season at which a lamb was born had an effect on the weaning weight and the gain on pasture. In all of

the crossbreeds and the several years studied the early dropped lambs were heavier at weaning than the lambs dropped after the middle of the lambing season. Early lambs have a more satisfactory environment for growth with the late lambs at a disadvantage having to compete with hot weather and parasites during an earlier stage in their growth.

3. The correlation coefficients between rainfall and lamb growth were not statistically significant, indicating that the rainfall during the pasture study did not have a marked influence on the growth of the lambs. The fact that the number of lambs were where necessary adjusted to the forage available at two week intervals may have had some effect on this analysis.

4. There was no apparent direct relationship between solar radiation and lamb growth during the pasture study. This may be due to the limited amount of data available and the adjustment of the pasture at two week intervals.

5. The coefficients of correlation between birth weights and weaning weights of all lambs studied in 1952 through 1954 were statistically significant. This follows the findings by other workers of a relationship between birth weight and subsequent growth rate.

6. The coefficients of correlation between the weight of the lamb with the weight of the dam at weaning for the Suffolk sired lambs were statistically significant. There was a trend toward significance for 1954 Columbia sired lambs but not significant for the other crossbred lambs studied. This difference can be attributed in part to the sires.

7. A comparison of the pasture growth of the crossbred lambs showed that the Suffolk sired lambs had the largest average daily gain and

weaning weight. There was no statistically significant difference between the pasture growth of the 1952 and 1953 Suffolk sired lambs. The results show that there was a significant difference in pasture growth of the Suffolk sired over the Columbia sired lambs in 1953. Statistically significant differences between the initial weight and growth of Columbia sired lambs and the initial weight and growth of Corriedale sired lambs were reported for 1954.

Weaning weights of single male lambs were heavier than those of single ewe lambs except for 1952. The single ewe lambs' average weaning weight was heavier than the twins' average weaning weight by as much as 10.7 pounds in the 1953 Columbia sired lambs and 10.2 pounds in the 1954 Corriedale sired lambs. These same differences were evident in the average pasture gains by the lambs.

The ability of Suffolk sired lambs to grow at this rapid rate is of economic importance to producers who find it necessary to produce fat lambs on pasture.

The 1954 lambs were weaned 28 days earlier than the lambs of previous years because of the inability of the lambs of the other years to gain during that 28 day period on the ewes. This appears to be the opportune time for grain supplementation to keep the lambs gaining providing the pasture does not serve this purpose.

It appears that 120 day weaning weights are practical provided that lambs are born early enough but if dropped late and left on the ewe too long on pasture, adverse effects may appear in the form of lowered daily gains for the lamb and ewes in a rundown condition. It appears that more work on time of weaning is necessary before positive statements can be made.

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