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South Dakota Sheep Field Day Proceedings and Research Reports, 1997

Animal Science Reports

1997

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SDSU

SHEEP 97-5

Summary

This study was initiated to determine the production advantage of selected on-farm performance tested rams mated to commercial ewes. Sixteen Suffolk spring ram lambs were selected from two cooperator purebred flocks over a 2-year period (1993 and 1994). Rams were selected based on a combination of growth data and visual appraisal of muscling. Pairs of rams, representing high (H) growth and average (M) growth for a given flock were randomly assigned to mate 30 commercial ewes per ram for a 21 or 35-day breeding period in the fall. Eight cooperator commercial flocks provided ewes for this study. Flock management practices were not modified other than to collect complete production records on the ewes and their offspring in this project. Information collected during this study included ewe reproductive efficiency, pre- and postweaning lamb growth performance and lamb carcass merit. Data from this study indicate a small but economically important advantage in lamb performance for rams selected for high (H) growth compared to average (M) growth. In this study it appears that, in one of seven pairs of rams evaluated, performance of progeny was reversed from that expected. It is expected that including larger number of rams and a wider divergence of sire performance would result in larger progeny effects. Based on the limited number of rams evaluated in this study, it appears that ram selection based on a combination of pre- and postweaning performance can be used to adequately identify superior sires for commercial sheep flocks. The additional value of progeny from H sires could exceed $500 per ram over a 3-year breeding period.

Key Words: Rate of Gain, Sheep, Sire Selection

Prepared for Sheep Day, June 12, 1997.

Introduction

Over the past 20 years the average finished lamb weight in the U.S. has increased from 104 to 126 pounds. Lambs have been fed to heavier weights to meet changes in merchandising practices and the consumers' demand for larger cuts of lamb. However, the increase in live weight and subsequently heavier carcasses has not uniformly led to leaner carcasses. The cuts of lamb must be leaner than ever before for the U.S. sheep industry to be competitive for the consumer's retail dollar. To meet the demands of the packer and consumer for leaner and larger cuts of lamb, the sheep industry must produce muscular, large-framed lambs. Terminal sires that will produce lambs with these desirable traits can benefit producers due to the rapid growth rate and greater feed efficiency, thus lower cost of gain, that is often associated with lean body weight gain.

By objectively evaluating growth traits of economic importance, producers can increase production efficiency, produce a more desirable market animal, and capitalize on favorable market conditions. A measurable indicator of growth is average daily gain (ADG). It is the key variable in the feed cost of gain when finishing lambs to slaughter weight. The economic impact which average daily gain has on flock profitability has yet to be fully realized by many in the sheep industry. Selection of rams using objectively measured

Appreciation is expressed to the National Suffolk Sheep Association and its board of directors for partial support for this project. Also, appreciation is given to Warren Rusche, Deuel County Extension Agent, Clear Lake SD, and various cooperators involved with this project.

performance information on economically important traits must be utilized in sheep production in the future. Visual appraisal is not enough anymore. Using a terminal sire with superior growth traits in a commercial sheep enterprise system can greatly increase lamb growth efficiency.

Central ram testing stations and on-farm performance testing are both useful in the evaluation of populations of animals. Since environmental effects are held constant for each type of test situation, true genetic differences on economically important traits are more easily identified. Central tests have been conducted in the United States for over 40 years. Typically, central ram tests evaluate young rams from many producers during an on-test period ranging from 56 to 84 days. Growth and more frequently carcass merit are monitored under constant feed and environmental conditions. Central tests monitor postweaning effects only. Most central tests have used the assumption that preweaning factors do not affect on-test performance. However, Waldron (1989b) concluded that pre-test management significantly affects on test performance and subsequently genetic differences among tested rams are masked.

For several decades producers have conducted on-farm performance testing within their flock to collect performance information similar to a central test. This type of performance test is limited since across flock comparisons are not valid due to management and other environmental differences. Waldron (1989a) has reported that within flock selection is effective in genetic improvement of reproduction, growth, and fleece weight. An advantage of on-farm testing is that individual pre- and postweaning growth performance can be measured. Genetic improvement through the selection of rams for rapid pre- and postweaning average daily gain may be a key resource producers need to meet the economic challenges in today's lamb production systems.

The objectives of our study were to determine the production advantage for growth and carcass traits in lambs sired by rams selected for rapid pre- and postweaning ADG.

Experimental Procedure

Four 4- to 5-month-old purebred Suffolk spring ram lambs from each of two purebred producers were selected in 1993 and 1994 for this study. Selection criteria were an index based on a composite of pre- and postweaning growth data (ADG) and subjective visual appraisal for muscling. High (H) performance rams were selected from the top 20% ranked rams and moderate (M) performance rams from at or near the midpoint of the performance rank. Subjective muscling scores were used to select within performance category. In the H rams, more muscle shape was favored, less muscle shape when selecting the M rams. In both cases rams were judged to be visually acceptable to commercial ram buyers.

The ranking tool for rams was a combined index of pre- and postweaning growth rate determined by the SHEP computer software package. Preweaning growth data of rams used as sires were adjusted for age of dam, type of lamb birth, and type of lamb rearing. Data from the purebred flocks were collected and submitted by the cooperator. The selection index was generated by SDSU personnel.

Rams were randomly paired (one H and one M from the same ram producer) for use in the commercial cooperator flocks. The pairs were allotted as listed in Table 1. All rams were semen tested at least 1 month prior to the breeding season. Sixty ewes at each location were assigned at random to each pair of rams, 30 ewes per ram, at the time of mating in order to equalize ewe effect on subsequent lamb performance. A 35-day breeding season was used for fall 1993 matings. This was shortened to 21 days for fall 1994 matings in order to better group slaughter dates on all lambs. Performance records were kept from birth to slaughter on all lambs produced. Carcass data were collected at a commercial slaughter plant by SDSU personnel. Commercial flock cooperators determined when lambs were sold for slaughter, but the target weight was 120 pounds.

Lamb growth performance was determined for weaning weight and postweaning average daily gain using data collected by each cooperator.

Table 1. Postweaning growth performance of selected rams

	High		Moderate	
Ram pairs[a]	Weaning wt, lb	Postweaning ADG[b], lb	Weaning wt, lb	Postweaning ADG, lb
A	59	1.36	44	1.03
B	75	1.29	46	1.02
C	92	1.56	52	1.29
D	84	1.33	66	.93
E	80	1.20	50	.95
F	74	1.24	56	1.00
G	64	1.16	58	.99
Means	75	1.31	53	1.03

[a]Pairs of rams were selected from two purebred Suffolk flocks during 1993 and 1994.
[b]Sixty-day postweaning growth period.

Using these data, several standardized performance measurements were calculated. Labels and formulas used were:

Labels:

WW = weaning weight
ADG = average daily gain
PWADG = postweaning average daily gain

Formulas:

PWADG: (Final slaughter weight - WW)/postweaning growth days to slaughter
Postweaning Days to 120 pounds: (120 lb - WW)/PWADG
Total days to 120 pounds: weaning age + postweaning days to 120 pounds

Data were analyzed as paired comparisons within cooperator flock using GLM procedures in SAS (1992). Main effects were flock, sire type, lamb sex, type of birth, and type of rearing. Contrasts were tested on the least square means (LS means) for each production variable when a significant interaction between flock and sire type was observed. In addition overall means were generated for performance and carcass measurements.

Due to unforeseen circumstances, one set of rams produced too few lambs for a valid comparison and their data have been excluded from the analyses. The progeny from the seven pairs of Suffolk spring ram lambs totaled 488 weaned lambs with 403 lambs slaughtered. Ewe lambs were not slaughtered in one flock.

Results and Discussion

Weaning weight and PWADG on the rams used to sire progeny is given in Table 1. The mean ADG for H rams was 1.31 pounds compared to 1.03 for the M rams. The sum of the postweaning performance differences across ram pairs equaled .24 pounds of body weight gain per day. With a summed difference of .24 pounds, the calculated expected difference between sire type is .036 pounds of gain per day in favor of the H rams. This calculation is based on the difference in ADG for each sire type, which was .24 pounds, times the sire's contribution to progeny for gain (.5), times the level of heritability for post weaning growth, .3.

Reproductive performance of ewes mated to these seven pairs of rams is shown in Table 2. Results indicate that reproductive performance was very similar between rams selected for H and M growth performance. In this study all ram lambs were semen tested and shown to be reproductively sound. However, as shown in Table 2, breeding success was variable between

Table 2. Reproductive performance of ewes mated to selected rams

Sire	High			Moderate		
Flock	No. exposed	Percent lambing	Lambs per ewe lambing	No. exposed	Percent lambing	Lambs per ewe lambing
A	31	90	1.93	32	88	2.00
B	30	68	1.48	31	63	1.21
C	33	100	1.30	26	100	1.50
D	35	60	1.60	36	58	1.90
E	35	37	1.60	35	29	1.40
F	30	90	2.00	30	90	2.14
G	31	71	2.00	31	81	2.04
Mean		73.7	1.70		72.7	1.74

flocks, ranging from 30 to 100% lambing. There appeared to be no difference within cooperator flocks. Length of breeding exposure, ewe breeding season, and flock management could all contribute to the wide range in percent lambing. Ewe reproductive performance was not analyzed statistically since ewes were randomly assigned to rams within flock. Schwulst and coworkers (1996) at Colby, KS, reported no difference in ewe productivity when high and low ranking central test rams were mated to commercial ewes.

Pre- and postweaning growth performance is shown in Table 3 for the progeny. Lamb weaning weight was not statistically different for the progeny of any pair of rams representing a single flock. The average weaning weight for all lambs on the study was 57.9 ± 10.7 pounds. The variation across flocks was large as might be expected with various ewe types and management systems represented by the different flocks. Schwulst and coworkers (1996) also showed no effect of sire type on weaning weight growth performance. Preweaning growth differences are expected to be more reflective of maternal traits, such as milk production, than sire effects. Differences in postweaning performance would most accurately reflect the genetic contribution from the sire.

Table 3. Progeny lamb performance

	Weaning wt, lb			Postweaning ADG, lb		
Flock	H	M	Diff	H	M	Diff
A	37.0	40.4	-3.4	.74	.83	-.089
B	72.8	74.4	+1.7	1.00	.92	+.082
C	53.5	51.8	+1.7	.75	.69	+.057
D	78.3	74.5	+3.8	.50	.46	+.047
E	67.9	68.6	-.7	.82	.84	-.018
F	46.0	49.0	-3.0	.73	.72	+.013
G	64.8	62.5	+2.3	.80	.81	-.004
Mean			+.3			+.013

[a]+ favor H rams, - favors M rams.

The average postweaning ADG was .76 ± .14 pounds. Postweaning growth rate varied by management system from 1.00 to .46 pounds. The difference between sire type within a flock favored the progeny of H rams. In six of the seven flocks postweaning lamb growth performance was statistically equal or favored the H performance rams. The overall difference in ADG for sire type was only .013 pounds. The expected difference in postweaning ADG in this study was .036 pounds per day. The data for flock A strongly support the M ram as the superior sire of this pair for progeny postweaning growth (P<.01). This error in selection can be contributed to a host of factors. It indicates that basing selection on one production record has low accuracy. Therefore, it is not surprising that one pair in seven failed to meet the criteria under investigation. Low accuracy is also noted in that the expected postweaning growth difference was .036 pounds per day while the observed difference was .03 pounds even without flock A.

In practice producers would benefit the most by mating ewes to rams selected from the top ranking performance tested rams for growth rate or other trait(s) of interest from high performance flocks. This procedure would help minimize the impact of selection errors due to the low accuracy on individual animal records.

The differences between ram type (H vs M) was relatively small, yet an increase in postweaning growth of .03 pounds per day translates into nearly 2 more pounds of lamb weight for a 60-day postweaning feeding period. Based on these results, every 100 lambs would produce 200 additional pounds of market weight. At $90 cwt this provides an additional $180 dollars per hundred lambs. This may seem trivial. Yet over a 3-year breeding lifetime it amounts to $540 dollars per ram. More importantly without positive selection pressure for this economically important trait, rams may be added which reduce growth performance by the same amount (.03 pounds per day). In this case there would be 2 fewer pounds gained per lamb over the feeding period. In a comparison the difference in profitability between these two scenarios is $1,080 dollars per ram over 3 years.

Other research on progeny performance of tested rams has yielded mixed conclusions. Waldron (1990) concluded that evaluating genetic merit of young ram lambs on 63-day central tests have low accuracy identifying superior rams for growth rate. Pre-test variables were shown to have a significant effect on test performance. Several biases arise in those studies as well as our study since the population of rams evaluated in this study had exceptional growth rate compared to the whole seedstock population in the U.S.

In contrast to the work by Waldron et al. (1990), researchers at the Kansas State University Northwest Extension Center at Colby reported a significant postweaning to finish rate of gain favoring high growth tested rams compared to low ranking rams. Schwulst et al. (1996) showed that progeny of high ranking central tested rams had 9% improved postweaning gain compared to progeny from the low ranking rams. The ADG of progeny was .62 for the high and .57 for the low. Weaning weight was similar, 39 pounds, and the lambs were slaughtered when they reached 110 pounds.

A tremendous challenge exists in identifying superior sires versus average or below average sires for growth performance of their progeny. Waldron (1989b) reported that preweaning factors can have a significant influence on postweaning growth rate, i.e., test performance. These could simply boil down to factors which affect weaning weight differences within or between flocks. The same could be said for on-farm performance selection since lambs at a lighter weaning weight will not likely perform at the same ADG as significantly heavier ram lambs over a typical 60-day monitored postweaning growth period. Indexes which adjust lamb weaning weight mask the disadvantage lighter lambs have during the postweaning growth period. The reasoning is lighter lambs can not or will not consume as much ration compared to the heavier lambs. Thus, weaned 45-pound ram lambs compared to those at 65 pounds have a built-in disadvantage for weight gain through a portion of a postweaning test period. With expected maximum feed intake at 3.5% of body weight, the lighter lambs would consume 1.5 pounds of diet and heavier lambs 2.3 pounds of diet per day or 50% more total pounds of feed consumed. The growth advantage for the heavier lambs is expected to be .06 pounds per day. Comparing rams at similar starting weights may help improve the accuracy for selecting superior rams on growth rate.

In our study we used two ways to evaluate the economic impact of the progeny of these tested sires, a calculated postweaning days to 120 pounds and total days to 120 pounds (Table 4).

The difference in postweaning days to 120 pounds between sire type was 2.5 days in favor of the H rams. Similar results were found when evaluating total days to 120 pounds. Since postweaning ADG drives these calculations, flock A had great influence on the average across flock differences for these variables. The results less flock A show nearly a 6-day advantage for the H rams using either days on feed calculation. These two measures of days on feed relate to the cost of gain. Six fewer days on feed translates into a feed savings of $2 per lamb. A wide variation in number of days to finished weight was observed across flocks. All flock management costs associated with a specific management scheme need to be evaluated before the most profitable lamb feeding program can be identified.

Table 5 shows carcass merit for the lambs in this study reported by flock for each sire type. No within flock differences for any measures of carcass merit were significant for sire type. As expected across flock comparisons reveal differences in most estimates of carcass composition including fat thickness, rib eye area, and percentage of boneless closely trimmed retail cuts (% BCTRC). In general these lambs were marketed at 120 pounds and fat thickness was .2 inches. Individual producers did a good job marketing lambs when the final live weight was near 120 pounds. The carcass data indicate that most lambs were lean at slaughter as indicated by the fat level. All lambs were Yield Grade 2 or lower except for flock G where the M lambs slide into the Yield Grade 3 category. Based on these data we feel the correct target weight endpoint was chosen for this study.

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Table 4. Progeny lamb performance[a]

Flock	Postweaning days to 120 lb			Total days to 120 lb		
	H	M	Diff[b]	H	M	Diff
A	116.9	99.4	+17.5	173.0	156.2	+16.8
B	48.3	54.9	-6.6	129.7	137.1	-7.4
C	92.2	104.5	-12.3	136.3	149.1	-12.8
D	84.0	97.8	-13.8	182.0	196.4	-14.4
E	64.4	60.5	+3.9	127.1	119.7	+7.4
F	72.8	75.6	-2.8	132.5	134.2	-1.7
G	72.5	78.0	-5.5	140.9	145.2	-4.3
Mean			-2.5			-2.3

[a]Calculated postweaning and total days to 120 pounds.
[b]Negative difference favors H rams, positive difference favors M rams.

Table 5. Carcass merit evaluation

Flock	Finished wt, lb		Carcass wt, lb		Fat thickness, in.		Body wall thickness, in.		Rib eye area, sq. in.		% BCTRC[a]	
	H	M	H	M	H	M	H	M	H	M	H	M
A	120.4	123.9	62.2	64.0	.21	.24	.93	.90	2.43	2.57	46.45	46.60
B	122.9	117.1	62.6	50.0	.21	.16	.83	.77	2.18	2.17	46.13	46.77
C	122.3	118.7	62.0	62.5	.17	.17	.79	.76	2.38	2.38	47.00	47.00
D	123.1	123.4	59.8	60.2	.13	.14	.67	.69	2.56	2.62	48.40	48.56
E	119.8	121.5	63.0	62.8	.25	.26	1.07	1.06	2.27	2.25	43.6	43.6
F	121.1	122.0	60.9	62.9	.21	.26	.89	.93	2.47	2.52	46.8	46.4
G	113.7	114.4	61.3	62.2	.26	.30	1.10	1.04	2.41	2.49	43.9	43.7

[a]% BCTRC = percentage of boneless, closely trimmed retail cuts.