

RESULTS FROM ADAPTABILITY TRIAL OF RAMBOUILLET SHEEP AND THEIR CROSSBREEDING WITH KAGHANIS. EFFECTS ON EWE MATING WEIGHT, WOOL PRODUCTION, LITTER SIZE AND LAMB GROWTH

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Summary

In order to upgrade native sheep, Rambouillet (R) rams were mated to Kaghani (K) ewes to generate F1 (R × K) crossbred ewes. Crossbred ewes were backcrossed to Rambouillet rams to produce B1 (R × F1), B2 (R × B1) and B3 (R × B2) genotypes. Weaning weight of 2605 lambs and wool weight of 2378 mature ewe records, representing R, K, F1, B1, B2 and B3 genotypes, were analyzed to compare genetic variation among genotypes produced during upgrading process and identify genotypes of the highest performance. Performance of Rambouillets was also evaluated under semi-temperate climate. Data were adjusted for yearly variation considering Rambouillet as a control. Genotypes influenced lambs weaning weight ($p < .01$). B1 lambs were heaviest (18.4 kg) followed in order by B2, F1, B3, R and K lambs (18.3, 17.9, 16.9, 16.8 and 13.2 kg, respectively). The highest wool production was 2.5 kg from R ewes followed by B2 (2.3), B3 (2.3), F1 (2.0) and K (1.2) ewes ($p < .01$). Ewe mating weight, reproduction, growth and wool production of Rambouillets deteriorated significantly after the first decade of their importation. Compared with the first phase (1959-1971), ewe mating weight, litter size, birth weight, lamb weaning weight and wool production declined by 20, 23, 32 and 36%, respectively, in the second phase (1972-1988).

(Key Words : Rambouillet, Crossbred, Backcross, Litter Size)

Introduction

Pakistan has over 20 million sheep. Slow growth and low reproduction rates are major concerns of the sheep industry in Pakistan. Meat is the major product of sheep production and it accounts for 20% of the total meat production in the country. Pakistan requires fine wool for apparel purposes but lacks fine wool sheep breeds. Increases in meat and wool production for the last decade are probably attributable to increases in sheep numbers without improvements in animal performance. High prices of wool and meat in the country suggest scarcity of both; however, due to limited land resources, increases in numbers of animals cannot be continued indefinitely. Adequate feeding of small numbers of high productive animals is more economical than

inadequate feeding of large numbers of lowly productive animals. Therefore, emphasis should be on increasing meat and wool production by improving genetic merits of animals. Improvement in productive traits could be made genetically through either selection or crossbreeding.

In Pakistan 61 percent of the sheep population are in flocks of 1 to 50 animals; only 7% of sheep are managed in flocks of 200 or more head. The large flocks are of migratory nature, managed mostly by illiterate people unfamiliar with scientific selection principles. There are no record keeping practices for evaluation on any flock in the private sector. All these factors suggest that the opportunity for genetic improvement of sheep in Pakistan through selection is probably limited. Therefore improvement efforts have concentrated on upgrading local sheep through crossbreeding, including use of Rambouillet sheep for grading up local Kaghani sheep. The present study was designed to compare weaning weights and wool production of various genotypes generated during the upgrading process. Assessment is also made of the performance of Rambouillets over time in Pakistan.

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Materials and Methods

Animals and Management. A Rambouillet breeding flock of 80 ewes and 5 rams was imported into Pakistan from the USA in 1957. The flock was kept at the Jaba Livestock Experiment Station, District Mansehra, where the climate conditions are relatively conducive to rear such animals.

The farm originally comprised 517 hilly acres, six percent of which has been under cultivation for maize/oats to be made into silage for winter feeding. Recently additional 60 acres of tillable land has been added to the farm to augment silage production. Most of the farm area is pasture land, covered predominantly with needle grass (*Heteropogon*) used for grazing. The average annual rain fall is 120 cm, most of which is received between July and September. Following the rainy season surplus grass is available for harvesting and conserving as hay for winter feeding. The yearly temperature varies from -3 to 38°C.

The feeding and managerial practices from 1957 through 1988 remained more or less the same depending on weather conditions and availability of feed. Feeding depended mostly on grazing during summer months, while hay and silage were fed during winter with daily supplementation of 200 to 400 grams of concentrates per head. Flushing was practiced prior to autumn breeding of ewes for spring lambing.

Since their importation, Rambouillets have been maintained as purebreds from 1957 to 1971 (phase 1) then used for crossbreeding with Kaghani sheep from 1972 to 1988 (phase 2). From 1972 to 1977 F1 ewes were generated by mating Rambouillet rams to a flock of Kaghani ewes purchased from local farmers. Ewes from the F1 crop were mated to Rambouillet rams to produce the first backcross (B1), with repeated backcrossing to produce B2 and B3 genotypes. A total of 1183 Rambouillet (R), 58 Kaghani (K), 207 F1, 380 B1, 541 B2 and 236 B3 lambs were produced between 1972 and 1988 and their weaning weights were used for the comparison of genetic groups. Ewes were shorn annually in the month of april and individual fleece weights were recorded between 1976 and 1987.

Statistical Procedure. Data were analyzed for lamb weaning weight (120 day) and wool pro-

duction from breeding ewes. Large year-to-year variation was observed, e.g. average weaning weight of Rambouillet lambs was 100% higher in the year of highest performance than in the year of lowest performance, and difference in wool production between extreme years was 36 %. Since the various genotypes were generated in different years (figure 1) weaning weight and wool data were adjusted for year effects based on the yearly variation observed in Rambouillets.

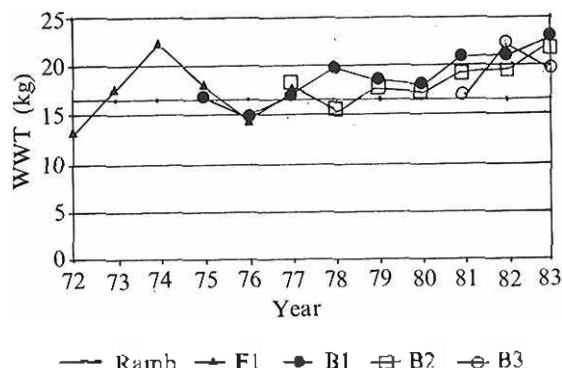


Figure 1. Lamb weaning weights of various genotypes.

Adjusted individual records were calculated as:

$$X_{ijk} = X_{ijk} + (X_r - X_{rj})$$

where X_r is the overall Rambouillet mean,

X_{rj} is the Rambouillet mean for jth year,

X_{ijk} is the observation of the individual of the ith breed group born in the jth year.

Adjusted weaning and wool weights were analyzed by general linear model procedures (SAS, 1986). Breed group and sex were used as fixed effects in the model for weaning weight analysis, whereas breed group and year were included as fixed effect in the model used for wool weight analysis. Multiple comparisons among genotype means were made using Student-Newman-Keul procedures (Sokal and Rohlf, 1969).

Wool production data from 100 Rambouillet ewes each with five shearings were used to calculate repeatability estimates. Repeatability was calculated from variance component estimates as $t = \sigma^2G / (\sigma^2G + \sigma^2E)$ where the between ewe variance component (σ^2G) was estimated by equating the between ewe mean square to its expectation, $\sigma^2E + K\sigma^2G$ (Becker, 1985).

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Results

Means and standard errors for lamb weaning weight and ewe wool production are shown in table 1. The overall mean weaning weight was 18 kg and ranged from 13 kg for straightbred Kaghani to 18 kg for B1 (R × F1) backcross.

F1 lambs were 29% heavier at weaning ($p < .01$) compared with their parental means. B1 and B2 lambs were 9% heavier at weaning than that of B3 and pure Rambouillets and 39% heavier than pure Kaghani lambs. Overall mean for wool production was 2.1 kg and ranged from 1.2 kg for Kaghani to 2.5 kg for Rambouillet ewes.

TABLE 1. LEAST SQUARE MEANS AND STANDARD ERRORS (kg) FOR EWE WOOL PRODUCTION AND LAMB WEANING WEIGHTS OF VARIOUS GENOTYPES

Genotype	Weaning weight			Wool production		
	No.	Mean	SE	No.	Mean	SE
Rambouillet (R)	1183	16.8 ^c	.11	1119	2.5 ^a	.01
Kaghani (K)	58	13.2 ^d	.39	22	1.2 ^d	.11
F1 = (R × K)	207	17.9 ^b	.28	398	2.0 ^c	.03
B1 = (R × F1)	380	18.4 ^a	.19	496	2.2 ^b	.02
B2 = (R × B1)	541	18.3 ^a	.17	301	2.3 ^b	.03
B3 = (R × B2)	235	16.9 ^c	.26	42	2.3 ^b	.08
Overall	2605	17.5	.23	2378	2.1 ^d	.05

^{a,b,c,d} Means in the same column without common letters in their superscript differ ($p < .05$).

Wool production from F1 ewes averaged 2.0 kg. F1 ewes showed 8% heterosis in wool production. Wool production was similar for B1, B2 and B3 ewes being 2.2, 2.3 and 2.3 kg, respectively, and 15% higher than F1 ewes ($p < .01$). Rambouillets weaning weights showed yearly variation without evidence of significant decline during the first 12 years (phase 1) following importation. In the last years of phase 1 and early years of phase 2, i.e. from 1970 to 1977 lamb weaning weight declined consistently and then leveled off showing yearly variation until the last part of phase 2. The same trend was true for ewes mating weight, birth weight and litter size declined in a similar fashion. Wool production declined somewhat in the starting years of phase 1 then leveled off until the last part of phase 1. A further major drop

in wool production was noticed during 1970 to 1975 and then production leveled off until the last year of phase 2.

Significant differences were observed between phase 1 and phase 2 for ewe mating weights, reproduction, growth and wool production of straightbred Rambouillets. Phase 1 means for ewe mating weight, litter size, birth weight, weaning weight and wool production of Rambouillet were 52 kg, 1.3 lambs, 4.3, 24.8 and 3.9 kg, respectively, (table 2). The phase 2 declines were 18, 20, 23, 32, 36% for ewe mating weight, litter size, birth and weaning weights of single lambs, and wool production, respectively. Wool production of 110 R ewes, each with five shearings, had a repeatability estimate of .50.

TABLE 2. MATING WEIGHT, REPRODUCTIVE, GROWTH AND WOOL PRODUCTION OF RAMBOUILLET PURE-BREDS DURING PHASE 1 (1959-1971) AND PHASE 2 (1972-1988)

Trait	Phase 1	Phase 2	% Change
Litter size	1.27	1.02	-20
Birth weight (kg) ^a	4.30	3.31	-23
Weaning weight (kg) ^a	24.76	16.78	-32
Ewe mating weight (kg)	52.00	44.00	-18
Wool production (kg)	3.94	2.51	-36

^a Single horn lambs.

Discussion

In an effort to upgrade local Kaghani Sheep by crossbreeding with Rambouillets, various genotypes ranging from 1/2 R:1/2 K to 15/16 R:1/16 K were generated. Genotypes were produced over a long period, during which administrative management changes probably affected animals performance. Even though adjustments have been made for yearly variation, one should be careful in generalizing the results of this study due to unavailability of all genotypes across all years. The results are important because they provide approximate comparisons of genotypes and suggest the need for well designed experiments in the future.

The superior performance of B1 and B2 lambs suggests that 3/4 to 7/8 Rambouillet inheritance is a desirable level for lamb production in the study environment. The superiority of B1 and B2 genotypes could be due to the advantage of a maternal heterosis effect which is not available to the F1s.

The light weaning weights of pure Kaghani lambs is indicative of breeds's low mature body weight. Weaning weights of purebred Rambouillets were lower than those of crossbreds. This is typical when performance of improved breeds from temperate climates is measured under semi-temperate or tropical conditions (Alderson et al., 1982; Mohan and Acharya, 1982). Similarity in performance of B3 and Rambouillet ewes is probably due to their genetic similarity since B3 genotypes have 92% Rambouillet genes.

Rambouillet is a fine wool breed which produces good amounts of wool. The Rambouillet genes in the crossbred ewes probably increased their wool production. The pattern of wool production indicated superiority of B1, B2 and B3 ewes over F1 ewes suggesting as Rambouillet genes increase in the genotype the wool production increases. Repeatability of wool production was close to the findings of Cochran et al. (1984) who reported a repeatability value of .60.

As seen in figures 1 and 2 crossbred lambs were generally heavier at weaning than straight-bred Rambouillet lambs, whereas wool production was higher for Rambouillet ewes than for crossbred ewes. This abnormally suggests that the optimal level of Rambouillet breeding depends on the production objective.

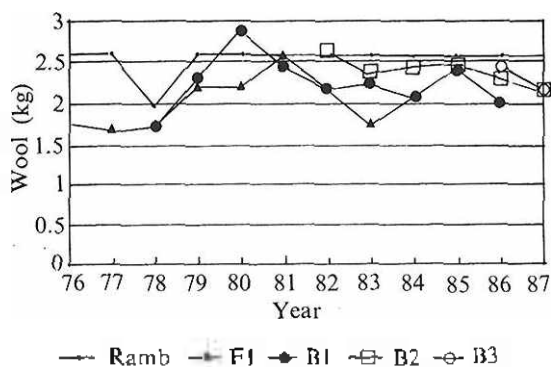


Figure 2. Ewe wool production of various genotypes.

Numerous factors could be responsible for the significant decline in the performance of Rambouillets in the second phase. The most important could be inbreeding effects as Khan (1986) estimated mean inbreeding of 9% for this flock. However, the negative effects of low body weight of ewes on reproduction and growth can not be ruled out. For example Polypay (Carry 25% Rambouillet genes) ewes showed significant relationship between body weight and reproductive performance (Nawaz and Meyer, 1991). Significant decline in litter size of Rambouillets during phase 2 may be partly explained by the findings of West et al. (1991) who have demonstrated that poor body condition ewes achieve lower embryo success, resulting in only a portion of ovulation increases from flushing being realized as lambs born. Moreover, the policy of increasing the flock size of the farm without increasing land area for grazing or supplying other feed and management resources might also have affected animal performance. Consequently, relatively sub-optimal feeding and management conditions could have exaggerated inbreeding effects.

Implications

Crossbreeding Rambouillet with local Kaghani breed produced improvement in both growth and ewe wool production of crossbred animals compared with Kaghani sheep. Compared with pure Rambouillets, differential response of crossbred animals for weaning weight and wool production suggests that the optimal level of Rambouillet breeding depends on the production objective. Significant decline in all production traits during 1970 to 1977 seems to be due to both inbreeding

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effects and suboptimal management. Introduction of new Rambouillet genes from outside and improved feeding should improve the productivity of the flock.

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