

THE EFFECTS OF CROSS-BREEDING ON INDIGENOUS WOOL WITH SPECIAL REFERENCE TO ITS PHYSICAL CHARACTERISTICS

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The physical characteristics of crossbred wools between indigenous Kaghani and Rambouillet have been investigated. The improvement, regarding quality and increase in production of crossbred wool, has been explained. The relationship between fibre diameter and quality of wool has been determined. The co-relation between crimp per inch and staple length has also been found out. The possible influence of pasture and climatic conditions on the quality of crossbred wools has been discussed.

Key words: Crossbreeding, Indigenous wool, Physical characteristics.

Introduction

With a view to produce fine wool, crossbreeding is being done in certain areas of Pakistan. It seems that detailed work has not been carried out on the crossbred wools. The present work, therefore, aims at achieving the following objectives:

- To investigate the physical characteristics of wool resulting from the crossbreeding between Kaghani and Rambouillet.
- To examine the effect of crossbreeding on improvement of wool quality and quantity.
- To underline the importance of crossbreeding for increased fine wool production.

Materials and Methods

Crossbreeding between Rambouillet and native Kaghani breed is being carried out in Jabba Farm, District Manshra. Similarly, cross-breeding is also being practised in other parts of the country viz. Muzafar Abad, Swat and Kaloor Kot (Mian Wali).

The total number of sheep heads in the Jabba Farm during the year 1987 were 750. Out of these 15 were Rambouillet rams for crossing. The total number of breeding ewes (adult) were 322. These ewes formed the total number of Kaghani, F_1 , F_2 , F_3 , F_4 , and F_5 breed leaving younger stock of over and below one year. These animals were kept under the same environmental condition throughout the year. The climate of the area is cold, the day temperature may go as high as 38° during summer and it may fall to -3° in winter. The average annual rain fall is about 120 cm, most of which is received in the month of July to Sept. However, some rain during spring is also received. Considerable quantity of grass is available for grazing, harvesting and making hay after the rainy season,

The normal procedure of cross-breeding is being followed in the farm. The various progineses resulting from the cross-breeding are denoted by F_1 , F_2 and so on.

Wool samples. For collection of samples, full fleeces of Rambouillet, Kaghani and cross-bred sheep from F_1 to F_5 were

obtained. The fleece of each sheep partitioned into back, belly, neck, body and britch and then about equal quantity of wool from each portion was randomly taken and mixed to form a composite representative samples. The samples thus obtained for each breed, representative of all parts of the fleece, were used for the following tests:

i. Measurement of fibre diameter. Ten sub-samples, one gram each were taken at random from the bulk samples for each breed. These sub-samples were then thoroughly cleaned with benzene and solid particles, burrs and seed were removed.

To determine the diameter [2], the clean fibres were aligned glass slides after being cut. 8 mm dissectionally and securing by the cover-slip using glycerine. These slides were then inserted into a projectional microscope (Lanameter) and the diameter of fibres was determined at a magnification of x 500. At least 800-1000 readings for each breed were recorded and diameter per each breed calculated (Table 1).

ii. Measurement of staple length. For measuring the staple length, about 50-80 staples at random were withdrawn from the bulk samples of each breed. The distance between the two ends of the staple was recorded after placing each staple on a meter rod (Table 2).

iii. Fibre length. About 800 wool fibres were randomly selected from each sample and measured one by one using footrule fixed on the velvet board. The measurement were made with the help of a pair of tweezers so that the wool fibres, properly straightened, were adjusted carefully to the zero mark on the footrule and the distance between the two ends was recorded (Table 3).

iv. Measurement of crimps. The total crimps for each staple were measured after placing the staple on the meter rod and counting the total number of waves between the two ends of the staple and finally crimps per inch were calculated. With a view to obtain a precise result 50-80 staples for each breed were withdrawn at random and their total number of crimps

were measured. Similar procedure has been followed for measuring fibre crips. However, in this case footrule fixed on velvet board was used (Table 3).

(v). *Fleece weight.* The grease fleeces of Kaghani ewes and the resulting crossbred fleeces of rams and ewes of F₃ and F₄ stages of crossing were weighed on a common balance. The inclusion of F₃ and F₄ stage fleeces were taken into consideration in view of the fact that the wool yield per fleece in F₃ and F₄ is almost equal and maximum as a consequence of the completion of entire stages of crossing (Table 4).

Results and Discussions

It is evident from the results (Table 1) that there is marked improvement in the fibre diameter as a result of crossbreeding. The mean average diameter of Kaghani, Rambouillet and the crossbred wools i.e. F₁ to F₅ are 32.10 μ , 21.06 μ , 25.25 μ , 23.47 μ , 21.44 μ , 21.16 μ , and 21.18 μ respectively. It may also be noted that at 4th stage (F₄) the diameter fineness becomes almost equal to that of pedigree (Rambouillet). The rate of decrease of fibre diameter is quite sharp in the first three stages

as compared to the F₄ and F₅ stages where negligible decrease has taken place. This indicates that beyond 4th stage no improvement takes place in fibre diameter.

The diameter range values for Rambouillet and crossbred wools are 20-22 μ , 24-27 μ , 22.24 μ , 20-22 μ , 20-22 μ and 21-22 μ respectively. Substituting grades for these ranges [5] the quality or fineness grades for F₁ is 58's-60's-64's for F₃ 64's -70's for F₄ 64's -70's and for F₅ 64's -70's. Generally the crossbred wools have a quality range from about 44's to 58's [4]. The results of the present investigations, therefore, lead to the conclusion that the cross breeding between Kaghani and Rambouillet are resulting in the production of fine grades of wool with quality range from 58's to 70's.

The mean average values of staple length and crimp per inch for Kaghani, Rambouillet, and crossbred wools are 4.96 and 2, 2.61 and 13, 2.30 and 9, 2.77 and 12, 2.75 and 13, 2.68 and 13 and 2.61 and 13 respectively. These results (Table 2) indicate that significant improvement has taken place, in crossbred wools, in regard to crimp frequency. The indigenous Kaghani with crimp frequency of 2 per inch, after crossing, has

TABLE 1. IMPROVEMENT IN FIBRE DIAMETER AND QUALITY AS A RESULT OF CROSS-BREEDING BETWEEN KAGHANI AND RAMBOUILLET.

S. No.	Kaghani diameter (μ)	Rambouillet diameter (μ)	Cross F ₁ diameter (μ)	Cross F ₂ diameter (μ)	Cross F ₃ diameter (μ)	Cross F ₄ diameter (μ)	Cross F ₅ diameter (μ)
1.	35.01	21.52	24.66	24.36	21.30	20.54	21.50
2.	29.32	21.75	25.20	24.02	20.16	21.20	21.74
3.	30.43	20.30	26.80	23.17	22.07	21.32	20.64
4.	33.70	20.70	24.35	22.35	22.35	21.60	20.67
5. Approx: 29-35 range		20.22	24.27	22.24	20.22	20.22	21.22
6. Average diameter	32.10	21.06	25.25	23.47	21.44	21.16	21.18
Fineness	40's - 54's	64's - 70's	58's - 60's	60's - 64's	64's - 70's	64's - 70's	64's - 70's

TABLE 2. THE EFFECT OF CROSS-BREEDING ON STAPLE LENGTH AND CRIMP PER INCH.

S. No.	Kaghani		Rambouillet		Cross F ₁		Cross F ₂		Cross F ₃		Cross F ₄		Cross F ₅	
	Staple length inch	Crimp per inch	Staple length inch	Crimp per inch	Staple length inch	Crimp per inch	Staple length inch	Crimp per inch	Staple length inch	Crimp per inch	Staple length inch	Crimp per inch	Staple length inch	Crimp per inch
1.	4.05	2	2.59	13	2.50	10	2.78	12	2.82	13	2.75	13	2.73	14
2.	4.64	3	2.57	13	2.53	9	2.69	12	2.81	14	2.65	14	2.66	13
3.	4.58	2	2.46	12	2.30	10	2.93	13	2.90	13	2.60	12	2.79	13
4.	5.18	2	2.43	13	2.23	9	2.78	11	2.94	14	2.55	13	2.68	12
5.	5.10	1	2.64	14	2.17	9	2.70	13	2.90	12	2.70	12	2.56	14
6.	3.74	2	2.72	12	2.28	9	2.78	12	2.70	14	2.65	13	2.45	13
7.	5.32	3	2.67	13	2.30	9	2.69	12	2.53	13	2.72	13	2.49	12
8.	4.18	2	2.55	13	2.29	9	2.80	11	2.50	14	2.60	12	2.58	13
9.	5.30	2	2.78	12	2.18	10	2.66	11	2.76	14	2.82	13	2.73	13
10.	5.55	2	2.72	14	2.29	9	2.96	14	2.70	13	2.72	14	2.50	14
Mean average	4.96	2	2.61	13	2.30	9	2.77	12	2.75	13	2.68	13	2.61	13
C.V. (%)	12.3	25.6	4.16	5.43	4.93	3.33	3.54	7.90	5.24	5.95	2.88	5.43	4.26	5.43

TABLE 3. THE EFFECT OF CROSS-BREEDING ON FIBRE LENGTH AND CRIMP PER INCH.

S. No.	Kaghani		Rambouillet		Cross F ₁		Cross F ₂		Cross F ₃		Cross F ₄		Cross F ₅	
	Fibre length inch	Crimp per inch	Fibre length inch	Crimp per inch	Fibre length inch	Crimp per inch	Fibre length inch	Crimp per inch	Fibre length inch	Crimp per inch	Fibre length inch	Crimp per inch	Fibre length inch	Crimp per inch
1.	5.50	3	3.20	19	2.50	10	3.62	10	4.41	16	4.13	20	4.40	20
2.	5.50	4	3.10	17	3.50	11	3.70	12	4.43	19	4.05	19	3.73	19
3.	6.80	3	2.95	18	2.70	10	5.01	11	4.35	19	4.20	20	3.90	18
4.	6.30	2	3.50	17	2.80	12	4.02	13	3.70	19	3.80	20	4.20	18
5.	5.00	3	3.45	19	3.00	12	4.20	15	4.48	19	8.83	22	3.74	17
6.	6.50	2	3.50	18	3.00	11	3.72	11	3.55	18	5.21	21	5.20	18
7.	5.80	3	3.70	18	2.70	10	4.25	15	3.62	17	4.46	20	3.90	18
8.	4.50	2	3.90	17	2.70	10	4.95	13	3.61	17	4.05	20	3.82	18
9.	5.80	3	3.50	19	2.50	12	4.42	14	4.23	20	4.35	19	3.80	18
10.	6.00	3	3.75	18	3.00	12	4.73	16	4.32	16	4.90	20	4.50	19
Mean average	5.77	3	3.45	18	2.85	11	5.26	13	4.17	18	4.29	20	4.19	18
C.V. (%)	11.29	21.08	8.18	4.30	9.90	8.13	11.40	14.59	9.29	7.45	10.01	4.18	7.39	4.64

TABLE 4. THE INCREASE IN GREASE FLEECE WEIGHT DUE TO CROSS-BREEDING BETWEEN LOCAL AND FOREIGN BREEDS.

S. No.	Kaghani	Fleece wt. of crossbred sheep (lbs)*			
	Fleece wt (lbs) Ewes	Ram.	Ram % increase	Ewe	Ewe % increase
1.	3.4	8.2	141	6.7	97
2.	3.5	8.7	148	7.3	108
3.	3.8	9.3	145	7.2	89
4.	3.5	8.8	151	6.8	94
5.	3.7	9.3	151	6.9	86
6.	3.6	8.5	136	7.0	94
7.	3.8	9.0	137	7.2	89
8.	3.7	9.1	146	7.4	100
9.	3.3	7.7	133	6.5	97
10.	3.5	7.9	126	7.0	100
Mean average	3.5	8.6	141	7.0	95

*The fleece weight of ewe and rams of F₃ and F₄ stages of crossing have been included.

resulted in 9 per inch (F₁), 12 (F₂) and 13 (F₃). It may also be noted that crimp frequency increases with increasing stage of crossing. However, when fineness reaches to maximum, the crimp frequency remains constant. The results show direct relationship between fineness and crimp per inch which is in agreement with the established work [5].

The results recorded for staple length (Table 2) show that the crossbred wools are having higher staple values than the Rambouillet with the exception of F₁ which is having lower values than the the Rambouillet. This may be due to the fact that genetic changes in regard to fibre (Table 3) and staple length in the first crossing stage are minimum. The higher staple values of crossbred wools are in close confirmity with the statement that (crossbred wools are having longer staple length than the crossing breed [6]). Such wools have the

advantage of having decreased noils in combing and good combing grade.

The average results of fibre length and crimp per inch for Kaghani, Rambouillet and crossbred wools indicate similar pattern of change as that shown in Table 2 i.e. fibre frequency increases with fibre fineness and fibre length was greater than that of Rambouillet except in the case of F₁ which was lower than the Rambouillet. Moreover, these results reveal that crimp frequency in fibres are greater than the crimp frequency in staples of wool. There is, however, no relationship between fibre crimps and staple crimp per inch. This is in agreement with the work of Shah *et al.* [7].

Menkart and Detenbeck [8] have carried out extensive studies on the significance of wool fibres crimp in worsted process and found that crimp persisted throughout procesing exerting an effect on the properties of the tops, roving yarn fabrics. The wool with more crimp produced twist less assemblies with greater cohesion, performed better in spinning, gave rise to bulkij yarn with lower breaking extension and produced a thicker with softer handle and smoother appearance [8].

The co-efficient of variations of staple length and crimps per staple (Table 2) and those of fibre length and crimps per fibre (Table 3) are indicating that C.V. (%) are much less in crossbred wools as compared to native Kaghani wool. It may also be noted that all C.V. values, of staple and fibre length and their corresponding crimp frequency, are lower. These findings provide the evidence for uniformity of length of crossbred wool. Uniformity of length determines whether the wool will be manufactured on the woollen or worsted system besides having the benefit of making uniform yarn from such wool [9].

The rise in grease fleece weight of crossbred sheep at F₃ and F₄ stages is more than double than the grease fleece weight of indigenous Kaghani ewes (Table 4). Generally the increase

in wool production per sheep is from 75 to 100% higher than that of the original breed. In the case of crossbreeding between Kaghani and Rambouillet the wool production per sheep, as obvious from Table 4, is in the highest limit in the case of ewes and is much higher than the recorded figure in the case of rams. This is thus evident that crossbreeding between these two breeds is most effective and ideal in regard to improvement in quality (64's to 70's) and wool production under the climatic conditions of cold to moderate temperature and abundance of pastures in the area of breeding.

Conclusion

The crossbreeding, in moderate cold climate with good pasture condition, between Rambouillet and native Kaghani results in fine quality of wool (58's to 70's) and increased wool production. The quality of crossbred wool are finer than the reported crossbred quality (48's to 58's). The number of crimps per inch increases with the increasing fineness of crossbred wools. The fibre crimps per inch are higher than the staple crimps but no definite relationship exists between the two. staple and fibre length of crossbred wools are greater than the selective breed. The co-efficient of variation

(C.V.) of fibre and staple length of crossbred wools are much lower than the Kaghani wool and is comparable with that of the Rambouillet wool.

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